

## **REQUEST FOR PROPOSALS SPECIFICATION NO. 06-266**

The City of Lincoln, Nebraska intends to enter into a contract and invites you to submit a sealed proposal for:

### **STARTRAN AUTOMATIC VEHICLE LOCATION SYSTEM**

Sealed proposals will be received by the City of Lincoln, Nebraska on or before 12:00 noon Wednesday, November 1, 2006 in the office of the Purchasing Agent, Suite 200, K Street Complex, Southwest Wing, 440 South 8th Street, Lincoln, Nebraska 68508. Proposals will be publicly opened at the K Street Complex, reading only the names of the firms submitting proposals.

Proposals may be downloaded from the City's website at [www.lincoln.ne.gov](http://www.lincoln.ne.gov) Keyword: Bid.

**Prospective proposers must monitor the listing for any addendums.**

A pre-submission meeting will be held at the Purchasing Division, 440 S. 8<sup>th</sup> St., Ste. 200, Lincoln, NE on Thursday, September 21, 2006 at 1:00 p.m. CDT. All proposers are encouraged to attend.

Proposers should take caution if U.S. mail or mail delivery services are used for the submission of proposals. Mailing should be made in sufficient time for proposals to arrive in the Purchasing Division, prior to the time and date specified above. Late proposals will not be considered. **Fax or e-mail proposals are not acceptable. Proposal response must be in a sealed envelope.**

COMPANY NAME \_\_\_\_\_

**PROPOSAL**  
**SPECIFICATION NO. 06-266**

**OPENING TIME: 12:00 NOON**  
**DATE: Wednesday, November 1, 2006**

The undersigned, having full knowledge of the requirements of the City of Lincoln for the below listed phases and the contract documents (which include Notice, Instructions, this Proposal, Specifications, Contract, and any and all addenda) and all other conditions of the Proposal, agrees to enter into a contract with the City the below listed fees for the performance of this Specification, complete in every respect, in strict accordance with the contract documents at and for fees listed below.

**ADDENDA RECEIPT:** The receipt of addenda to the specification numbers \_\_\_\_\_ through \_\_\_\_\_ are hereby acknowledged. Failure of any submitter to receive any addendum or interpretation of the specifications shall not relieve the submitter from any obligations specified in the request. All addenda shall become part of the final contract document.

Note: Mandatory – Attach line item pricing for each item.

| <u>Item No.</u> | <u>Description</u>                                    | <u>Total Price</u> |
|-----------------|---|--------------------|
| 1.              | CAD/AVL software (sect. 3.1, 3.2, 3.3, 3.4, 3.5, 3.6) | \$ _____           |
| 2.              | Hardware, general (sect 3.7)                          | \$ _____           |
|                 | Differential GPS Reference Receiver (sect. 3.7.7)     | \$ _____           |
|                 | On-Board Vehicle equipment (sect. 3.7.9)              | \$ _____           |
|                 | Maintenance Equipment for Next Stop (sect. 3.7.12)    | \$ _____           |
| 3.              | Documentation (sect. 3.8)                             | \$ _____           |
| 4.              | Training, Support, and Maintenance (sect. 3.9)        | \$ _____           |
|                 | Spare parts & test equipment (sect. 3.9.2)            | \$ _____           |
| 8.              | Inspection and Testing (sect. 4)                      | \$ _____           |
| 9.              | Project Management (sect. 5)                          | \$ _____           |
|                 | Total Base Price                                      | \$ _____           |

### Optional Items

- |    |  |          |
|----|--|----------|
| a. | Base Monitoring (sect. 3.1.8)                    | \$ _____ |
| b. | Mechanical Alarms (sect. 3.1.9.6)                | \$ _____ |
| c. | Vehicle Operator Training Hardware (sect. 3.7.8) | \$ _____ |
| d. | Wireless LAN Interface (sect. 3.7.9.9)           | \$ _____ |
| e. | Base Wireless LAN (sect. 3.7.10)                 | \$ _____ |

### Add/Delete Prices

The following prices will be used to change the contract price based on the addition or deletion of the described item from the contract quantities.

| <u>Description</u>                       | <u>Add Price</u> | <u>Delete Price</u> |
|--|------------------|---------------------|
| APC equipment for bus with 2 doors, each | \$ _____         | \$ _____            |
| APC equipment for bus with 1 door, each  | \$ _____         | \$ _____            |
| ADA Announcement Controller, each        | \$ _____         | \$ _____            |
| GPS vehicle system with MDT              | \$ _____         | \$ _____            |
| GPS vehicle system without MDT           | \$ _____         | \$ _____            |

**PROPOSAL SECURITY REQUIRED:** \_\_\_\_\_ **YES**

\_\_\_\_\_ **X** \_\_\_\_\_ **NO**

**AFFIRMATIVE ACTION PROGRAM:** Successful proposer will be required to comply with the provisions of the City's Affirmative Action Policy (Contract Compliance, Sec. 1.16). The Equal Opportunity Officer will determine compliance or non-compliance with the City's policy upon a complete and substantial review of successful proposer's equal opportunity policies, procedures and practices.

The undersigned signatory for the proposer represents and warrants that he has full and complete authority to submit this proposal to the City, and to enter into a contract if this proposal is accepted.

**RETURN 2 COMPLETE COPIES OF PROPOSAL AND SUPPORTING MATERIAL.**

**MARK OUTSIDE OF PROPOSAL ENVELOPE:**

**SEALED PROPOSAL FOR SPEC. 06-266**

**COMPANY NAME**

**BY (Signature)**

**STREET ADDRESS or P.O. BOX**

**(Print Name)**

**CITY, STATE**

**ZIP CODE**

**(Title)**

**TELEPHONE No.**

**FAX No.**

**(Date)**

**E-MAIL ADDRESS**

**ESTIMATED COMPLETION (DAYS)**

## APPENDIX A, 49 CFR PART 20--CERTIFICATION REGARDING LOBBYING Certification for Contracts, Grants, Loans, and Cooperative Agreements

*(To be submitted with each bid or offer exceeding \$100,000)*

The undersigned [Contractor] certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for making lobbying contacts to an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form--LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions [as amended by "Government wide Guidance for New Restrictions on Lobbying," 61 Fed. Reg. 1413 (1/19/96). Note: Language in paragraph (2) herein has been modified in accordance with Section 10 of the Lobbying Disclosure Act of 1995 (P.L. 104-65, to be codified at 2 U.S.C. 1601, *et seq.*.)]

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31, U.S.C. § 1352 (as amended by the Lobbying Disclosure Act of 1995). Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

[Note: Pursuant to 31 U.S.C. § 1352(c)(1)-(2)(A), any person who makes a prohibited expenditure or fails to file or amend a required certification or disclosure form shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such expenditure or failure.]

The Contractor, \_\_\_\_\_, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 U.S.C. A 3801, *et seq.*, apply to this certification and disclosure, if any.

\_\_\_\_\_  
Signature of Contractor's Authorized Official

\_\_\_\_\_  
Name and Title of Contractor's Authorized Official

\_\_\_\_\_  
Date

**Buy America Requirements** - The contractor agrees to comply with 49 U.S.C. 5323(j) and 49 C.F.R. Part 661, which provide that Federal funds may not be obligated unless steel, iron, and manufactured products used in FTA-funded projects are produced in the United States, unless a waiver has been granted by FTA or the product is subject to a general waiver. General waivers are listed in 49 C.F.R. 661.7, and include final assembly in the United States for 15 passenger vans and 15 passenger wagons produced by Chrysler Corporation, and microcomputer equipment and software. Separate requirements for rolling stock are set out at 49 U.S.C. 5323(j)(2)(C) and 49 C.F.R. 661.11. Rolling stock must be assembled in the United States and have a 60 percent domestic content.

A bidder or offeror must submit to the FTA recipient the appropriate Buy America certification (below) with all bids or offers on FTA-funded contracts, except those subject to a general waiver. Bids or offers that are not accompanied by a completed Buy America certification must be rejected as nonresponsive. This requirement does not apply to lower tier subcontractors.

**Certification requirement for procurement of steel, iron, or manufactured products.**

*Certificate of Compliance with 49 U.S.C. 5323(j)(1)*

The bidder or offeror hereby certifies that it will meet the requirements of 49 U.S.C. 5323(j)(1) and the applicable regulations in 49 CFR Part 661.5.

Date \_\_\_\_\_

Signature \_\_\_\_\_

Company Name \_\_\_\_\_

Title \_\_\_\_\_

*Certificate of Non-Compliance with 49 U.S.C. 5323(j)(1)*

The bidder or offeror hereby certifies that it cannot comply with the requirements of 49 U.S.C. 5323(j)(1) and 49 C.F.R. 661.5, but it may qualify for an exception pursuant to 49 U.S.C. 5323(j)(2)(A), 5323(j)(2)(B), or 5323(j)(2)(D), and 49 C.F.R. 661.7.

Date \_\_\_\_\_

Signature \_\_\_\_\_

Company Name \_\_\_\_\_

Title \_\_\_\_\_

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### Revision History

| Revision | Issue Date  | Status    | Authority          | Comments                  |
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# 1 INTRODUCTION

This document applies to the StarTran Automated Vehicle Location (AVL) System. The document control number for this document is contained in the document footer and the file name for the electronic rendition of the document is recorded in the table of contents for the document.

Requirements for the current version of the system will be included in the body of this specification. Potential requirements for future versions of the system will be included in the body but will be identified as low priority or “Future”. Whenever possible, the constraints on these future requirements are included as an explanation as to why they have not been implemented.

## 1.1 Purpose

The purpose of this procurement specification is to provide a basis for a contract between the City of Lincoln and a system supplier. The specifications identify the requirements governing the design of the StarTran AVL System (hereafter referred to as the **System**) and are the benchmark for the design verification and validation of the system. The intended audience for this document includes decision makers, stakeholders, contractors, designers, and testers.

## 1.2 Scope

The City of Lincoln, Nebraska’s StarTran, as a fixed route and demand-responsive transit provider, wishes to improve the operational efficiency and security of its transit system. These desires can be summarized in three main goals:

- Increased availability of transit information and dissemination;
- Improved overall dispatching and operating efficiency; and
- Increased driver and passenger safety and security.

StarTran is tasked with providing these improvements while minimizing additional expenditures or personnel. The existing system, because of the inherently manual nature of its data sharing, precludes the ability to increase system efficiency without application of additional resources.

Like many other transit system operators, StarTran has identified AVL technology deployment as a method to accomplish these goals. Specifically, the appropriate implementation of Intelligent Transportation System (ITS) technology to improve data accuracy and reduce communication delays offers the potential to meet these three main goals without additional personnel resources, and with minimal, if any, increase in recurring operational costs. Further, the City of Lincoln desires that any System provide future expandability and interoperability capabilities for other City of Lincoln (or even State of Nebraska) fleets, as well as neighboring transit providers. Given this desire, a stand-alone system is unlikely to satisfy the system requirements. Therefore, StarTran, along with the City of Lincoln and a grant from the Federal Transit Administration (FTA), has undertaken the process to design an open AVL System.

This specification defines the required and optional functionality for the System, including the AVL, Computer Aided Dispatch (CAD), fixed route scheduling, bus announcement, Automated Passenger Counting (APC), and reporting sub-systems.

### **1.3 Definitions, Acronyms, and Abbreviations**

This document may contain terms, acronyms, and abbreviations that are unfamiliar to the reader. A dictionary of these terms, acronyms, and abbreviations can be found in Appendix A.

### **1.4 References**

The following documents contain additional information pertaining to this project or have been referenced within this document.

1. *IEEE Std 830-1998, IEEE Recommended Practice for Software Requirements Specifications*, ISBN 0-7381-0332-2 SH94654, The Institute of Electrical and Electronics Engineers, Inc., 1998.
2. *IEEE Std 1233-1998, IEEE Guide for Developing System Requirements Specifications*, ISBN 0-7381-0337-3 SH94659, The Institute of Electrical and Electronics Engineers, Inc., 1998.
3. *Request for Proposals, Specification No. 05-053*, City of Lincoln, Nebraska, March 2005.
4. *Consulting Services for Automated Vehicle Location System Proposal*, Mixon/Hill, Inc., April 2005.
5. “*Application for Participation in the Fiscal Year (FY) 2004 Intelligent Transportation System (ITS) Integration Component of the ITS Deployment Program – AVL System for StarTran*”, StarTran, January 20, 2005.
6. *National ITS Architecture*, Federal Highway Administration (FHWA), 2003.
7. Title 23 Code of Federal Regulations (CFR) §940 (ITS Final Rule), and as referenced in Title 49 CFR §600 (FTA Regulations).
8. “*StarTran Automated Vehicle Location System, Concept of Operations*”, November 2005, Mixon/Hill, Inc.
9. “*StarTran Automated Vehicle Location System, System Architecture*”, January 2006, Mixon/Hill, Inc.
10. “*StarTran Automated Vehicle Location System, System Requirements*”, April 2006, Mixon/Hill, Inc.

### **1.5 Overview**

The organization and content of this document is based on the IEEE standards for System Requirements Specifications. The requirements presented in this document are intended to be a complete list of the relevant desires for the System.

Each requirement is identified by a unique number to allow the requirement to be referenced in future documents, providing traceability throughout the development process.

This specification states what must be accomplished to fulfill the vision described in a concept of operations. It does not state how it is to be accomplished. This document describes each requirement and the basis for inclusion of that requirement.

The remaining sections of the document contain the requirements for the system. The sections and their content are as follows:

**Section 2 – General Description** provides a general overview of the entire system. This section describes the general factors that affect the system and its requirements.

**Section 3 – Specific Requirements** contains the detailed requirements developed from reference documentation and stakeholder meetings. This section organizes the requirements into categories that facilitate the design and testing process. These categories are:

- Functional Requirements
- External Interface Requirements
- Performance Requirements
- Design Constraints
- General System Qualities
- System Upgradability
- Reporting and Data Management
- Hardware
- Documentation
- Training, Support, and Maintenance

**Section 4 – Inspection and Testing** describes the inspection and testing requirements for acceptance of the system.

**Section 5 – Project Management** describes the interface between the Owner's project personnel and the Contractor, and the schedule, quality assurance, and documentation requirements for the project.



## 2 GENERAL DESCRIPTION

This section provides a general overview of the entire System and describes the general factors that affect the system and its requirements. This section does not state specific requirements, but instead is intended to make the requirements easier to understand by giving them context.

### 2.1 *Product Perspective*

As a fixed route and demand-responsive transit provider, StarTran wishes to improve the operational efficiency and security of its transit system. These desires can be summarized in three main goals:

- Increased availability of transit information and dissemination;
- Improved overall dispatching and operating efficiency; and
- Increased driver and passenger safety and security.

StarTran is tasked with providing these improvements while minimizing additional expenditures or personnel. The existing system, because of the inherently manual nature of its data sharing, precludes the ability to increase system efficiency without the application of additional resources.

StarTran has identified the use of technology as a cost-effective method to achieve operational improvement and accomplish the three main goals. Specifically, the appropriate implementation of ITS technology to improve data accuracy and reduce communication delays offers the potential to meet the three main goals without additional personnel resources, and with minimal, if any, increase in recurring operational costs.

In November 2003, funding for the implementation of a StarTran ITS system was included in the FY 2004 Federal Transportation Appropriations Bill. This funding provides the ability to implement a system that will help StarTran more efficiently and effectively accomplish the three main goals above.

### 2.2 *Product Functions*

StarTran has initiated this project to acquire several transit ITS technologies, including AVL, CAD, Fixed Route Scheduling, Automated Announcement system, Automatic Passenger Counting, and Reporting. Many of these technologies may be packaged together in a single application and others may be packaged separately. The set of technology components and applications shall comprise:

- Differential Global Positioning System (GPS) – providing satellite-based location tracking of transit vehicles (buses and paratransit vehicles), maintenance vehicles, and field supervisor vehicles with reporting capabilities to a central dispatch facility;
- Fleet management software – utilizing GPS location data and other information to support real-time schedule and route adherence monitoring, dispatching, communications management, and alerts monitoring;

- Mobile data terminals (MDTs) – on-vehicle devices to manage two-way messaging between operators and dispatchers and to gather vehicle and route performance data for subsequent download into maintenance management systems and for future route and schedule planning activities;
- Onboard annunciators – Americans with Disabilities Act (ADA)-required components providing visual and audible presentation of stops and other service announcements;
- Automated passenger counting – collecting information on ridership for the routes;
- Vehicle component monitoring – onboard sensors to monitor critical vehicle components and systems, and to provide information via an MDT (either in real-time or through end-of-day download) about imminent equipment failures or for routine maintenance monitoring; and
- Passenger information systems – providing linkages to web sites, and displays and kiosks at boarding locations that provide passengers with information about routes and schedules, service interruptions and delays, and, potentially, real-time wait times.

Figure 1 is a conceptual diagram of how the system components may be functionally arranged.

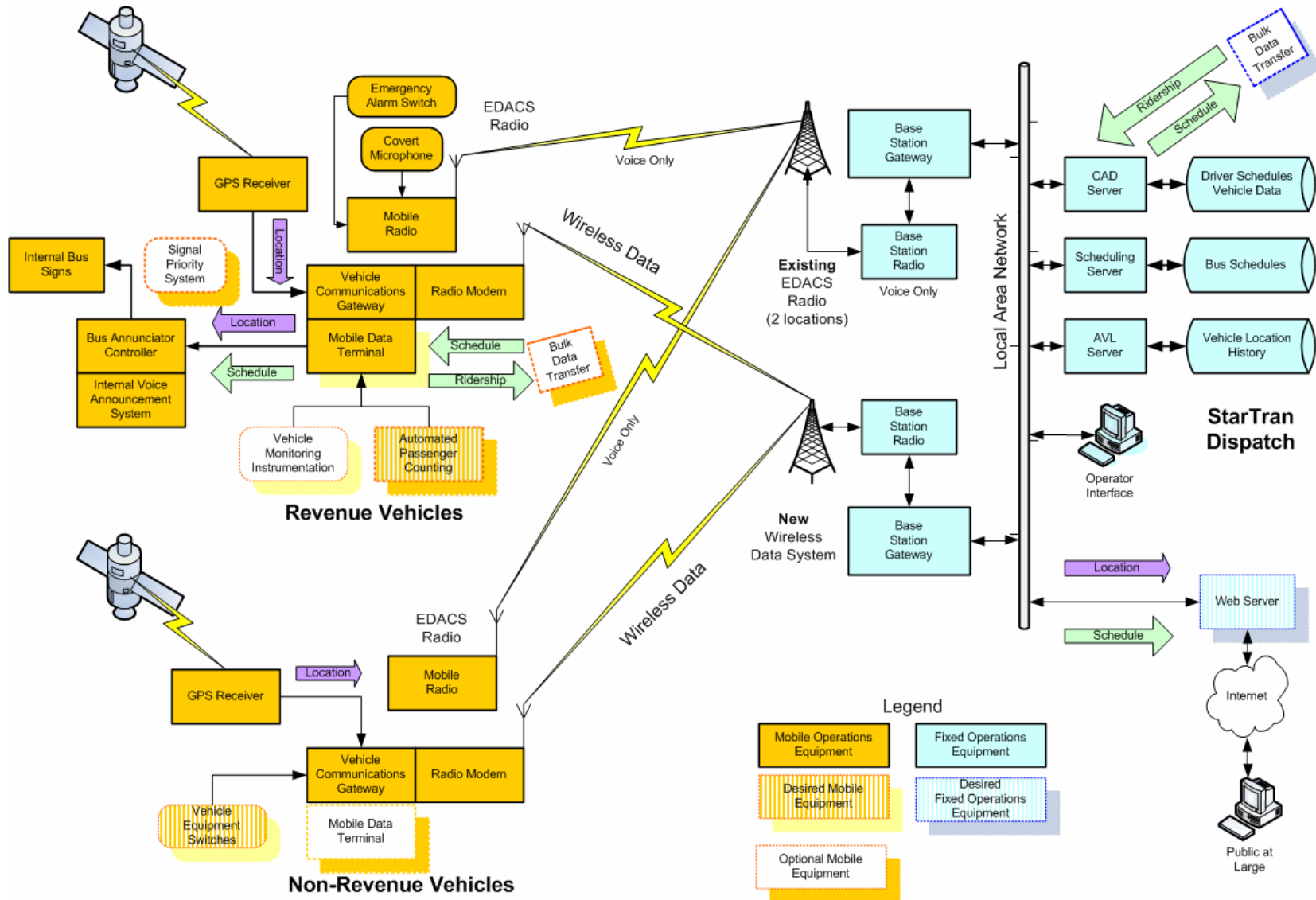


Figure 1 - System Functional Block Diagram

## **2.3 User Characteristics**

The following subsections describe each of the user classes for the current StarTran system. Each description includes system responsibilities and existing interactions with the system.

### **2.3.1 StarTran Management and Administrative**

StarTran management and administrative staff are characterized as personnel who work primarily in the StarTran office. This includes program supervisors, office managers, customer service representatives, and accounts personnel. Their responsibilities include:

- Establishing budgets;
- Providing supervisory oversight;
- Responding to customer requests;
- Aggregating and reporting financial information; and
- Aggregating and reporting ridership information.

This group of users will have business level proficiency in using personal computers. They will access the AVL system through the Operations, CAD, Scheduling, and Reporting user interfaces. They will require training on how to use the AVL system and the above user interfaces.

### **2.3.2 Dispatchers/Field Supervisors**

StarTran dispatchers are characterized as personnel who manage the StarTran bus operators. This includes the operations superintendent and field supervisors. Their responsibilities include:

- Ensuring fixed-route service schedule adherence;
- Providing communication between bus operators and customer service representatives;
- Determining location of currently active buses;
- Scheduling demand-responsive or special transportation service requests; and
- Communicating assistance requests from the bus operator to the appropriate emergency or fleet maintenance personnel.

This group of users will have business level proficiency in using personal computers. They will access the AVL system through the Operations, CAD, Scheduling, and Fleet Management user interfaces. They will require training on how to use the AVL system and the above user interfaces.

### **2.3.3 Fleet/Bus Maintenance**

StarTran fleet maintenance personnel are characterized as those individuals that directly maintain fleet equipment. This includes the maintenance superintendent, the garage supervisors, and the mechanic staff. Their responsibilities include:

- Preventative maintenance of StarTran buses and other vehicles;

- Emergency repair of StarTran buses and other vehicles;
- Scheduling preventative fleet maintenance;
- Maintaining and managing parts inventory for the fleet; and
- Installation and repair of the System equipment on fleet vehicles.

This group of users will be proficient in the installation and maintenance of vehicle electronics systems. They will require training as to the specifics of installing the vehicle equipment procured under this contract.

#### **2.3.4 Bus Operators**

StarTran bus operators are characterized as those individuals that directly operate the buses and other vehicles that carry bus riders. This includes both StarTran bus operators, paratransit vehicle operators, and Transport Plus bus operators. Their responsibilities include:

- Safely operating their individual buses and vehicles;
- Providing customer service to bus riders;
- Ensuring route and schedule adherence; and
- Providing bus/equipment repair notification.

This group of users may have limited computer user skills. They will access the System through the MDTs. Operators will require training on how to use the MDTs and on all of the user interfaces available on the vehicles.

#### **2.3.5 IT/Radio/Telecommunications**

IT, radio, and telecommunications personnel are characterized as those individuals that install, maintain, and operate the various information systems used by StarTran. This includes computer personnel, network engineers, radio technicians, and telecommunications specialists. Their responsibilities include:

- Installing new computers, computer networks, and radio and telecommunications systems;
- Maintaining and operating existing computers, computer networks, and radio and telecommunications systems;
- Support and administration of Oracle<sup>®</sup> relational databases; and
- Supporting City of Lincoln and Lancaster County agencies in their use of computers and networks, radio systems, and telecommunications systems.

System maintenance scheduling is based on planned preventive system maintenance, as well as reaction to unforeseen system failures. In most cases, the technicians are trained and certified by the Original Equipment Manufacturer (OEM) vendors for the equipment they service. This user group will be responsible for installation, administration, and service for any new server equipment, relational database software, and desktop computer software.

### **2.3.6 Bus Rider/Customers**

StarTran bus riders are characterized as those individuals that utilize StarTran for public transportation within the City of Lincoln. This includes those individuals who use the fixed service, the demand-responsive service, and the special transportation services such as during University of Nebraska – Lincoln (UNL) football games. Their responsibilities include:

- Safely using the StarTran service;
- Obtaining appropriate fare, route, and schedule information; and
- Providing the appropriate payment for service.

These customers include people with visual, hearing, and other disabilities which must be accommodated by the system in accordance with the requirements of the ADA. No minimum level of literacy or computer proficiency can be assumed for this user class, although most riders will be able-bodied, literate, and familiar with the route they are riding.

These users will be familiarized with the capabilities of the system affecting them through a StarTran public outreach campaign.

### **2.3.7 Traveling Public**

The traveling public includes potential customers who are seeking information about StarTrans routes, schedules, and fares. Their responsibilities include:

- Obtaining appropriate fare, route, and schedule information.

These potential customers include people with visual, hearing, and other disabilities which must be accommodated by the system in accordance with the requirements of the ADA. A moderate level of computer literacy can be assumed for this user group.

These users will be familiarized with the capabilities of the system affecting them through a StarTran public outreach campaign.

## **2.4 General Constraints**

Several assumptions and constraints were considered during the ConOps development. This includes both internally and externally imposed considerations.

First, the initial development of this system is funded under fiscal year (FY) 2004 FTA §5208 Federal-aid earmark.

Second, because this project includes FTA funds, it must comply with the FTA Policy which incorporates 23 CFR §940, otherwise known as the FHWA ITS Final Rule. These regulations require subject projects to utilize an ITS architecture, appropriate National ITS Standards, and a systems engineering process commensurate with the project size and scope.

Third, the system will be in place for many years, and thus must be able to accommodate increased ridership through expansion or modification of System capabilities. System expansion or modification will likely be conducted with StarTran operational funds, and must therefore be performed in an extremely cost-effective manner. On balance, the

system must be able to perform its functions with no net increase in StarTran support staff.

Fourth, the System must be designed in such a way as to allow future interconnection with other regional systems. For example, the StarTran System may interconnect with the Omaha Metro Area Transit (MAT) system, at least allowing for system redundancy in the event of a homeland security or other emergency situation. The System may integrate with the following systems operated by the Lincoln Metropolitan Planning Organization (MPO):

- Arterial Management System
- Incident Management System
- Management and Operations System
- Information Management/Data Archiving System

Finally, future enhancements to the System may integrate with the Lancaster County Emergency Management systems, as well as management, payment, traveler information systems, and maintenance systems operated by the City of Lincoln, the State of Nebraska, and Nebraska Department of Roads (NDOR).

## **2.5 *Assumptions and Dependencies***

### **2.5.1 Computer Platforms**

The City of Lincoln provides hardware and administrative support to StarTran for all servers. The City uses Hewlett-Packard (HP) Pentium processor based servers and would prefer to have HP equipment purchased for this system for ease of support. The City would consider purchasing the server equipment to the contractor's specifications if this would facilitate the preferred equipment. Servers are currently maintained by the City and are upgraded or replaced on a three-year cycle.

Dispatchers currently have 1 to 2 year old Hewlett-Packard (HP) desktop computers with 2.4 GHz Pentium processors, Windows XP, and 40 to 80 GByte hard drives. The City would prefer to retain these computers and use them for this system.

The City currently uses the Windows operating system predominately, with some Novel servers providing login authentication. The City would prefer software running on Windows 2003 (or newer) for the servers and Windows XP for any laptops and desktop applications. There is no strong preference for the operating system on the MDTs.

The City currently operates a clustered Oracle database server. Several smaller SQL Server deployments exist that are specific to applications. The City would prefer to implement any database services on the existing Oracle server, but would consider a SQL Server implementation if the system does not require support from a local database administrator.

### **2.5.2 Communications**

The voice communications equipment for the vehicles will be purchased in a separate procurement. The data communications equipment for the System will be the responsibility of the AVL contractor, while the City will be responsible for the cellular

data service contract for the data radios. The data communications interface for the System components in the vehicles will need to be coordinated with the contractor for the cellular data service furnished by the City. Likewise, the communications interface between the System fixed-base equipment and the City furnished cellular data service will need to be coordinated.

Cellular data service will be a minimum of 1xRTT, with most of the wireless carriers indicating that EVDO will be available by the time that the service contracts are finalized.

### 2.5.3 Standards and Specifications

Industry standards and specifications applicable to the System are shown in Table 1.

**Table 1 - Standards and Specifications for the StarTran System**

| Standard                       | Description   |
|--------------------------------|---|
| HTTP                           | HyperText Transfer Protocol – Version 1.0 available at: <a href="http://www.w3.org/Protocols/rfc2616/rfc2616.html">http://www.w3.org/Protocols/rfc2616/rfc2616.html</a>   |
| EIA RS-232<br>RS-422<br>RS-485 | Three Electronic Industry Association/Institute for Electrical and Electronic Engineers (EIA/IEEE) standards for serial line communications interfaces. The RS-232 standard uses low voltage (5 volts or less) signals over 9 conductor or 25 conductor cables, with a maximum transmission distance of 100 ft. Both RS-422 and RS-485 use a twisted-pair wire (i.e. 2 wires) for each signal. They both use the same differential drive with identical voltage swings: 0 to +5V and support transmission distances up to 4000 ft. The main difference between RS-422 and RS-485 is that while RS-422 is strictly for point-to-point communications (and the driver is always enabled), RS-485 can be used for multi-drop systems (and the driver has a tri-state capability).  |
| IEEE 802.11                    | 802.11 (also known as Wi-Fi) refers to a family of specifications developed by the IEEE for wireless LAN technology. 802.11 specifies an over-the-air interface between a wireless client and a base station or between two wireless clients. The IEEE accepted the specification in 1997.<br><br>There are several specifications in the 802.11 family: <ul style="list-style-type: none"> <li>• 802.11 -- applies to wireless LANs and provides 1 or 2 Mbps transmission in the 2.4 GHz band using either Frequency Hopping Spread Spectrum (FHSS) or Direct Sequence Spread Spectrum (DSSS).</li> <li>• 802.11a -- an extension to 802.11 that applies to wireless LANs and provides up to 54 Mbps in the 5 GHz band. 802.11a uses an orthogonal frequency division multiplexing encoding scheme rather than FHSS or DSSS.</li> <li>• 802.11b (also referred to as 802.11 High Rate or Wi-Fi) -- an extension to 802.11 that applies to wireless LANs and provides 11 Mbps transmission (with a fallback to 5.5, 2, and 1 Mbps) in the 2.4 GHz band. 802.11b uses only DSSS. 802.11b was a 1999 ratification to the original 802.11 standard, allowing wireless functionality comparable to Ethernet.</li> <li>• 802.11g -- applies to wireless LANs and provides 20+ Mbps in the 2.4 GHz band.</li> </ul> |
| IEEE 802.16e                   | 802.16 (also known as Wi-MAX) refers to a family of specification for metro-access wireless Ethernet for fixed and mobile applications. Wi-MAX will be certified in the 2.5-3.5 GHz spectrum for licensed deployments, and in the 5 GHz spectrum for unlicensed deployments. The specification defines data rates up to 75 MBps when 20 MHz channels are used. A typical 7 km (4 mile radius) cell with 10 MHz channels can usually support a 22 Mbps data rate.  |



| Standard            | Description   |
|---------------------|---|
| <b>IEEE 802.3ae</b> | <p>IEEE 802.3ae defines a version of Ethernet with a nominal data rate of 10 Gbps, ten times faster than <u>gigabit Ethernet</u>. The new 10-gigabit Ethernet standard encompasses seven different media types for <u>LAN</u>, Metropolitan Area Network (<u>MAN</u>) and Wide Area Network (<u>WAN</u>). It is currently specified by a supplementary standard, IEEE 802.3ae, and will be incorporated into a future revision of the IEEE 802.3 standard. Media types include:</p> <ul style="list-style-type: none"> <li>• <u>10GBASE-SR</u> ("short range") -- Designed to support short distances over deployed <u>multimode fiber</u> cabling, it has a range between 26 m and 82 m depending on the cable type. It supports 300 m operation over a new 2000 MHz-km multimode fiber.</li> <li>• <u>10GBASE-CX4</u> -- Copper interface using <u>Infiniband</u> cables for short reach applications (such as aggregation switch to <u>router</u>). This is currently the lowest cost per port interface at the expense of transmission range.</li> <li>• <u>10GBASE-LX4</u> -- Uses <u>wavelength division multiplexing</u> to support ranges between 240 m and 300 m over deployed multimode cabling, and supports 10 km over single mode fiber.</li> <li>• <u>10GBASE-LR</u> and <u>10GBASE-ER</u> ("long range" and "extended range") -- These standards support 10 km and 40 km respectively over single mode fiber. Recently several manufacturers have introduced 80 km range ER pluggable interfaces.</li> <li>• <u>10GBASE-SW</u>, <u>10GBASE-LW</u> and <u>10GBASE-EW</u> -- These varieties use the WAN PHY, designed to interoperate with OC-192/STM-64 <u>SONET/SDH</u> equipment. They correspond at the physical layer to 10GBASE-SR, 10GBASE-LR and 10GBASE-ER respectively, and hence use the same types of fiber and support the same distances. (There is no WAN PHY standard corresponding to 10GBASE-LX4.)</li> </ul> <p>Unlike earlier Ethernet systems, 10-gigabit Ethernet is based entirely on the use of <u>optical fiber</u> connections. However, the IEEE is developing a standard for 10-gigabit Ethernet over twisted pairs (10GBaseT), using Cat-6 or Cat-7 cable and planned for approval in 2006. Additionally, this developing standard is moving away from local area network design, with broadcasting to all nodes, towards a system which includes some elements of wide area routing. It is claimed that this system has high compatibility with earlier Ethernet and IEEE 802 networks.</p> |
| <b>JPEG</b>         | Joint Photographic Expert Groups. Compression technique that causes some detail to be lost during compression.  |
| <b>MJPEG</b>        | Motion JPEG. A moving image which is made by storing each frame of a moving picture sequence in JPEG compression, then decompressing and displaying each frame at rapid speed to show the moving picture.   |
| <b>MPEG</b>         | Moving Picture Experts Group. Family of digital video compression standards and file formats. There are three major standards: MPEG-1, MPEG-2 and MPEG-4.   |
| <b>NMEA-0183</b>    | National Marine Electronics Association standard for electrical interfaces and data protocol for communications between marine instrumentation. The standard includes the RMC message definition, which is the Recommended Minimum Content message for GPS/Transit data. The standard is based on an EIA RS-422 electrical interface.   |
| <b>NTCIP 1403</b>   | TCIP – Passenger Information (PI) Business Area Standard.   |
| <b>NTCIP 1404</b>   | TCIP – Standard on Scheduling/Runcutting (SCH) Objects.   |
| <b>NTCIP 1405</b>   | TCIP – Standard on Spatial Representation (SP) Objects.   |
| <b>NTCIP 2202</b>   | NTCIP Transport Profile for Internet (TCP/IP and UDP/IP).   |
| <b>NTCIP 2303</b>   | NTCIP Application Profile for File Transfer Protocol (FTP).   |
| <b>NTCIP 2306</b>   | NTCIP XML in ITS Center-to-Center Communications.   |
| <b>SAE J1708</b>    | Standard for serial data communications between microcomputer systems in heavy-duty vehicle applications.   |
| <b>SAE J2266</b>    | Location referencing Message Specification (LRMS).  |
| <b>SAE J2353</b>    | Data Dictionary for Advanced Traveler Information System (ATIS).  |
| <b>SAE J2354</b>    | Message Set for Advanced Traveler Information System (ATIS).  |
| <b>SAE J2374</b>    | National Location Referencing Information Report.   |
| <b>SAE J2529</b>    | Rules for Standardizing Street Names and Route IDs.   |
| <b>SAE J2540</b>    | Messages for Handling Strings and Look-Up Tables in ATIS Standards.   |
| <b>TMDD</b>         | Traffic Management Data Dictionary (see ITE TM 1.03).   |
| <b>XML</b>          | eXtensible Markup Language – Version 1.0 of the specification is available at: <a href="http://www.w3.org/tr/2000/REC-xml-20001006.html">http://www.w3.org/tr/2000/REC-xml-20001006.html</a> .  |
| <b>XSLT</b>         | eXtensible Stylesheet Language Transformations – Version 1.0 of the XSLT specification is available at: <a href="http://www.w3.org/tr/1999/REC-exslt-19991116.html">http://www.w3.org/tr/1999/REC-exslt-19991116.html</a> .   |

### 3 SPECIFIC REQUIREMENTS

This section presents the detailed requirements for the System and the associated institutional program necessary to achieve the needs and goals described in the Concept of Operations for the System. In this section, the requirements are divided into a number of categories as follows:

- **Functional Requirements** – Lists the characteristics that the software must support for each human interface. Identifies what is to be done by the product, what inputs should be transformed to what outputs, and what specific operations are required.
- **External Interface Requirements** – Details logical characteristics between the system and external data sources. Specifies level of integration with external systems and other sub-systems. Specifies any communications interfaces and protocols that should be supported.
- **Performance Requirements** – Specifies static and dynamic capacity for number of users, connections, and other performance related factors.
- **Design Constraints** – Identifies requirements imposed by standards, regulations, or hardware limitations.
- **General System Qualities** – Provides requirements which address the general quality, usability, extensibility, flexibility, and maintainability of the system.
- **Hardware** – Addresses requirements for hardware provided for the system.
- **Documents** – Identifies the required documentation for the system.
- **Training, Support, and Maintenance** – Provides requirements for training of the Owner’s personnel, support services to be provided by the Contractor, and maintenance equipment and support to provided by the Contractor.

Table 2 shows the general layout of the requirements tables, and explains the purpose or content of each column of the requirements table.

**Table 2 - Explanation of the Requirements Tables**

| ID  | Requirement   | Priority  |
|---|---|---|
| The requirement identification (ID) number is a unique identifier used to trace requirements from beginning to end in a system development process. | This column in the table contains the text of the actual requirement. | A priority for each requirement is assigned in this column:<br><br><b>H</b> – indicates that it is essential to the project,<br><b>M</b> – indicates that it should be implemented (budget and schedule permitting), and<br><b>L</b> – indicates “nice to have”, but only if there is little or no cost impact. |

### 3.1 Functional Requirements

StarTran (hereinafter referred to as the Owner) desires a system that provides a comprehensive set of transit operation and dispatch functions and features that will allow for effective and efficient monitoring and control of the Owner's revenue and non-revenue vehicles and transit services. This collection of functions and features will be referred to as the System.

Throughout this specification, the term "system user" is used as a generic term that applies to all users of the System including, the dispatchers who monitor and control bus operations, paratransit dispatchers who monitor and control paratransit operations, service supervisors, and all other personnel who have access to the System. The term "dispatch center personnel" is used throughout this specification to refer to the fixed route and paratransit dispatching personnel located in the dispatch center and other system users who are assigned, and have access to, the same functional capabilities as the dispatch center personnel, such as the dispatch center manager.

The term "Contractor" will be used to refer to the vendor or system supplier who is under contract to provide the System to the Owner.

#### 3.1.1 Automatic Vehicle Location Functions

The Owner desires a System that provides location data on off-route or behind-schedule vehicles at least once every 15 seconds, and location data for all other vehicles at least once every 60 seconds. Vehicles will be grouped into fleets, and operators should be able to view AVL data for one or more fleets.

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.1.1.1 | The System shall provide both the vehicle operators and System users with accurate and timely vehicle position data at all times while the vehicles are running.  | H        |
| R3.1.1.2 | Each vehicle location datum shall be accompanied by a timestamp representing the time at which the vehicle was at the expressed location.   | H        |
| R3.1.1.3 | Each vehicle's current location shall be reported to the System whenever schedule or route adherence thresholds are exceeded, whenever any communications request or other data is being transmitted from the vehicle to the System, and at least every 2 minutes if no other data transmissions or communications requests are initiated from the vehicle. | H        |
| R3.1.1.4 | The System shall store the latest vehicle location in the System database.  | H        |
| R3.1.1.5 | The System shall publish a text file for each fleet grouping that provides the latest vehicle ID, location, timestamp, and data status flags for each vehicle in the fleet grouping.  | H        |
| R3.1.1.6 | The System shall forward data traffic between the vehicle data terminal and the System.   | H        |

### 3.1.1.1 Vehicle Location and Status (Map-Based)

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.1.1.1.1 | The System shall provide authorized system users with detailed geographical maps of the Owner's service area showing the current locations and schedule/route adherence status of all vehicles on a fleet by fleet basis.   | H        |
| R3.1.1.1.2 | The Owner shall be able to select whether all System-equipped vehicles are displayed on each system user's geographical map display or whether only the vehicles or fleets within a system user's assigned data partition(s) are displayed.   | H        |
| R3.1.1.1.3 | The capability to select which vehicles are displayed shall be provided at all workstations that are equipped for the display of geographical maps.   | H        |
| R3.1.1.1.4 | A vehicle's location shall be updated on the geographical map overlay each time new valid vehicle position data is obtained from the vehicle.   | H        |
| R3.1.1.1.5 | Position data that is known to be invalid shall not be used for displaying vehicle locations.   | H        |
| R3.1.1.1.6 | In such cases where a vehicle is reporting an invalid position, the last known valid position of the vehicle shall be displayed, and used for schedule and route adherence purposes, until valid position data is received.   | H        |
| R3.1.1.1.7 | Vehicle status information conveyed by this function shall include, but not be limited to, the following attributes: <ul style="list-style-type: none"> <li>a. Schedule status (early, on-schedule, or late)</li> <li>b. Route status (on-route or off-route)</li> <li>c. Type of vehicle</li> <li>d. Logon status (logged-on, not logged-on)</li> <li>e. Direction of travel.</li> </ul> | H        |
| R3.1.1.1.8 | System users shall be able to quickly and easily configure their map view to show only the attributes that they wish to see.  | H        |

### 3.1.1.2 Information Storage Functions

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.1.1.2.1 | The System shall provide an information storage function that collects and stores all operational data for future retrieval and analysis. | H        |

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.1.1.2.2 | The operational data to be collected and stored by the System for future retrieval shall include, but not be limited to: <ol style="list-style-type: none"> <li>1. Records of all events and incidents,</li> <li>2. All data transmitted from the vehicle fleet including: <ol style="list-style-type: none"> <li>a. log-on/log-off data</li> <li>b. communications requests</li> <li>c. mechanical alarms</li> <li>d. data messages</li> <li>e. schedule and route adherence status data</li> <li>f. vehicle location data</li> <li>g. automatic passenger counter data</li> <li>h. data transmitted from other equipment on-board the vehicles</li> <li>i. all data collected from the vehicles via bulk data transfers</li> </ol> </li> <li>3. All data and messages transmitted to the vehicles,</li> </ol> | H        |
| R3.1.1.2.3 | The stored data shall be time/date stamped and shall contain sufficient information to enable the selective sorting and retrieval of the data based on user-specified selection criteria.   | H        |
| R3.1.1.2.4 | Schedule/route deviation data shall include a date/time stamp, vehicle ID, run/block number, trip number, direction, vehicle location data, employee ID, and the magnitude of the schedule/route deviation.   | H        |
| R3.1.1.2.5 | The most recent historical data shall be immediately accessible online to any authorized system user.   | H        |
| R3.1.1.2.6 | The online (short-term) accessible data shall include all historical data from the present to at least the past 3 months.   | H        |
| R3.1.1.2.7 | Online data older than the short-term cutoff shall be automatically transferred to long-term archive storage at pre-defined intervals by the City.  | H        |

### 3.1.1.3 Playback

The primary users of the playback function are expected to be the customer service representatives and operations planning personnel.

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.1.1.3.1 | The System shall include an off-line historical data playback capability that enables authorized system users connected to the Owner's corporate LAN to selectively retrieve data for playback via System displays.                                 | M        |
| R3.1.1.3.2 | System users shall be able to specify the dates and times for the start and end of the playback, control the speed and execution of the playback, start and stop the playback, fast forward and rewind the playback, and pause/resume the playback. | M        |
| R3.1.1.3.3 | System users shall be able to specify that all data within a time period be played back and that only data pertaining to user specified vehicles, routes, or route/runs be included in the playback.  | M        |
| R3.1.1.3.4 | The System shall provide a convenient means for users to start a playback beginning at any selected date and time.  | M        |

| ID          | Requirement   | Priority |
|-------------|---|----------|
| R3.1.1.3.5  | System users shall not be required to playback data for an extended duration in order to properly initialize the system conditions at the beginning of the playback period specified by the playback user.                            | M        |
| R3.1.1.3.6  | The normal online operation of the System at other system user workstations shall be unaffected by the playback function.   | M        |
| R3.1.1.3.7  | The playback capability shall be available to system users and to other authorized users with access to the playback service.   | M        |
| R3.1.1.3.8  | All playback users shall have concurrent access to all System historical data.  | M        |
| R3.1.1.3.9  | Within the time and date limits of the data that is available on the server, customer service representatives shall be able to determine the location and schedule/route adherence status of any vehicle at a specific time and date. | M        |
| R3.1.1.3.10 | Playback users shall be able to display all pertinent data associated with each vehicle, including the vehicle ID, route number, run/block number, vehicle operator ID, and vehicle operator name.                                    | M        |
| R3.1.1.3.11 | Playback users shall be able to playback all data associated with a vehicle by selecting or entering the vehicle ID, route number, run/block number, vehicle operator ID, or vehicle operator name.                                   | M        |
| R3.1.1.3.12 | Playback users shall be able to display the progression and schedule adherence of selected vehicles or all vehicles on selected routes via the playback function.   | M        |
| R3.1.1.3.13 | The Contractor shall provide all necessary System software required to implement the playback function on at least six (6) workstations.  | M        |
| R3.1.1.3.14 | The System shall enable up to six (6) playback sessions to be active concurrently.  | M        |

#### ***3.1.1.4 Fleet Data Import and Export***

The system must be able to import and export fleet location data in a standard format.

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.1.1.4.1 | The System shall import data from a standard file containing location data for one or more vehicles in a fleet as specified in Section 3.2.3.2.      | H        |
| R3.1.1.4.2 | The System shall archive and display imported fleet data in the same manner as fleet location data collected directly by the system.                 | H        |
| R3.1.1.4.3 | The System shall export the location data for each fleet that is directly monitored by the System in separate files as specified in Section 3.2.3.2. | H        |

### 3.1.2 Computer Aided Dispatch Functions

#### 3.1.2.1 Voice Communications

All voice communication for this system will use the Owner's existing EDACS 800 MHz trunked radio system. This system will not support any additional data communications.

#### 3.1.2.2 Data Communications

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.1.2.2.1  | The System shall support the transfer of data to and from the vehicle fleet and supervisory vehicles.  | H        |
| R3.1.2.2.2  | A non-proprietary data communications protocol shall be used to ensure the reliable delivery of data and control commands over the data channels.  | H        |
| R3.1.2.2.3  | Protocol parameters, such as timeouts and retry counts and intervals, shall be –adjustable by the System Administrator.  | M        |
| R3.1.2.2.4  | Data communications errors shall be logged and excessive errors and communications failures shall be alarmed to the appropriate system users.  | M        |
| R3.1.2.2.5  | If a polling scheme is utilized to retrieve data transmissions from the vehicles, the System shall poll all active in-service vehicles at least every two minutes.   | M        |
| R3.1.2.2.6  | If an exception reporting scheme is employed for initiating communications with the vehicles, all vehicles shall report to the System whenever data is available for transmission and every 15 seconds whenever a revenue vehicle is operating either off-schedule or off-route. | M        |
| R3.1.2.2.7  | Each active vehicle shall initiate “health-check” transmissions whenever no exception report transmissions have been made for a period of two minutes.   | M        |
| R3.1.2.2.8  | The System shall verify that it receives at least one transmission, either an exception report or a health-check, from each active vehicle on a regular basis; this verification shall be performed at a pre-set period, adjustable only by the System Administrator.            | M        |
| R3.1.2.2.9  | The System shall alarm and log all active vehicles failing to report in during each period.  | M        |
| R3.1.2.2.10 | If any other reporting scheme is employed (e.g., non-poll, non-exception), all data transmissions shall be retrieved from all active in-service vehicles at least every two minutes.   | M        |
| R3.1.2.2.11 | The System shall receive and process all data received from vehicles, even when the vehicle is not logged in.  | H        |

#### 3.1.2.3 Bulk Data Transfer

The primary objective of this function is to eliminate the need to transfer large data files to and from vehicles via the radio system when major schedule changes occur, when routine software, configuration, and other modifications are required on the vehicles, and when data needs to be uploaded from vehicles, e.g. Automated Passenger Counting (APC) data.

Vehicles not requiring such data transfers need not be equipped for bulk data transfers.

Bulk data transfers are only required to occur at the base terminal. Systems capable of bulk data transfers from other locations are acceptable.

Since all buses are fueled and washed each day, the wash bay and diesel fuel bay of the StarTran base terminal site is considered a good candidate for wireless bulk data transfers.

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.1.2.3.1 | The system shall be equipped to provide transfer of large amounts of data between revenue vehicles and the System servers as required to support the APC, ADA announcements, and other data required for operation of the System.   | H        |
| R3.1.2.3.2 | Bulk data supported by this function shall provide for the transfer of schedule route definition data including routes, schedules, trips, runs, time-points, display/annunciator trigger points, map data, and other data required by the vehicles as dictated by the Contractor's design approach. | H        |
| R3.1.2.3.3 | The System shall support downloading of schedule and announcement data as required (typically with every schedule update).  | H        |
| R3.1.2.3.4 | APC data upload from vehicles shall be supported on at least a daily basis.   | H        |
| R3.1.2.3.5 | The bulk data transfer function shall provide for download of updated audio announcement data and visual display data for all revenue vehicles.   | M        |
| R3.1.2.3.6 | All equipment and software required to transfer the data to/from the vehicles shall be provided.  | M        |

#### 3.1.2.4 Identifier Field Formats

The system will need to apply appropriate identifiers to uniquely identify all vehicles supported by the System, all vehicle operators, and all service routes operated by the Owner.

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.1.2.4.1 | Fixed route service vehicles shall be identified by fleet, run/block numbers, and vehicle IDs.                 | H        |
| R3.1.2.4.2 | Paratransit service vehicles shall be identified by fleet, route numbers, and vehicle IDs.                     | H        |
| R3.1.2.4.3 | Vehicle operators shall be identified by employee IDs.   | L        |
| R3.1.2.4.4 | Non-revenue vehicles and revenue vehicles in non-revenue service shall be identified by fleet and vehicle IDs. | H        |

#### 3.1.2.5 System Events

The System will need to support the gathering, processing, storage, and presentation of events relating to vehicles and vehicle operators and to the status of the System. All events should include sufficient identifying and descriptive data necessary for a user to properly interpret the event.

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.1.2.5.1 | The System shall support multiple event types and subtypes. | M        |



| ID          | Requirement   | Priority |
|-------------|---|----------|
| R3.1.2.5.2  | Events shall be available within the System for presentation, processing, and storage.  | M        |
| R3.1.2.5.3  | The System shall support Data Message Events – a text message from a vehicle operator to a System user.   | M        |
| R3.1.2.5.4  | Each canned data message shall be distinguishable as a unique data message subtype and shall be configurable by the System Administrator to any supported priority level.   | M        |
| R3.1.2.5.5  | The System shall support Schedule Adherence Violation Events – an event indicating that a vehicle is off schedule (early/late) by more than the threshold amount.   | M        |
| R3.1.2.5.6  | The schedule adherence violation message shall indicate the amount of schedule deviation in minutes.  | M        |
| R3.1.2.5.7  | The System shall support Route Adherence Violation Events – an event indicating that a vehicle is off route.  | M        |
| R3.1.2.5.8  | The System shall support Turn-back Events – an event indicating that a revenue vehicle has performed an unscheduled turn-back on its scheduled route.   | M        |
| R3.1.2.5.9  | The System shall support Log-on Alarm Events– an event indicating that a vehicle has pulled out without a valid vehicle operator logon.   | M        |
| R3.1.2.5.10 | The System shall support Operator Invalid Logon Events – an event indicating a failure of a vehicle operator logon. An invalid logon event shall be reported after three (3) consecutive failed logon attempts.   | M        |
| R3.1.2.5.11 | The System shall support Operator Logon/Logoff Events – events indicating successful Operator logons and logoffs.   | M        |
| R3.1.2.5.12 | The System shall support Late Pullout Events – events indicating that a revenue vehicle is late in pulling out for the start of revenue service.  | M        |
| R3.1.2.5.13 | The System shall support Mechanical Alarm (MA) Events – an event indicating a mechanical problem on a vehicle.  | M        |
| R3.1.2.5.14 | The System shall support System Alarm Events – events indicating a failure within the System itself, such as communications errors and failures or mobile component failures.   | M        |
| R3.1.2.5.15 | Event priorities shall be initially set by the Contractor, but shall be adjustable by the System Administrator.   | M        |
| R3.1.2.5.16 | All events shall be stored by the System and, if appropriate, shall be presented to the appropriate System users according to their data partition assignments.   | M        |
| R3.1.2.5.17 | Stored event history shall include at least the following data: <ul style="list-style-type: none"> <li>a. All data pertaining to the reported event</li> <li>b. Event parameter data, if any (e.g., message text)</li> <li>c. Date/time of creation (at the source location of the event)</li> <li>d. Date/time of receipt (at the fixed end)</li> <li>e. Date/time of selection (by user)</li> <li>f. Identification of selecting user</li> <li>g. Data regarding the disposition of the event (e.g., incident report generated).</li> </ul> | M        |
| R3.1.2.5.18 | The history of all logged events shall be accessible via the Information Storage and Retrieval functions.   | M        |

| ID          | Requirement   | Priority |
|-------------|---|----------|
| R3.1.2.5.19 | The System shall be sized to store at least 1000 events per day with archive capacity for 90 day retention.   | M        |
| R3.1.2.5.20 | System users shall be permitted access to events to the extent permitted by their assigned data partition(s).   | M        |
| R3.1.2.5.21 | System users with read-only access to specific events shall be able to view the events, but they shall not be permitted to respond to (i.e., acknowledge, open incident, reply, log, etc.) the events.  | M        |
| R3.1.2.5.22 | System users shall not be permitted to view events to which they do not have at least read-only access.   | M        |
| R3.1.2.5.23 | The System shall always ensure that events are promptly presented to at least one active (i.e., logged-on) system user.   | M        |
| R3.1.2.5.24 | Events not assigned to a data partition and events in data partitions without a current active user shall be routed to at least one active system user, as defined by the Owner, regardless of the data partition assignment(s) of that user. | M        |
| R3.1.2.5.25 | When an event is routed to a user, the system user receiving the event shall have full access to the event.   | M        |

### 3.1.2.6 Event Presentation

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.1.2.6.1 | The System shall enable system users to rapidly and efficiently detect and respond to events.   | M        |
| R3.1.2.6.2 | Events shall be presented to system users in a manner that emphasizes the most urgent events requiring response.  | M        |
| R3.1.2.6.3 | Redundant events shall be eliminated in order to reduce the presentation of unnecessary events.   | M        |
| R3.1.2.6.4 | Where different mechanical alarms are being reported for the same vehicle, the most recent unacknowledged alarm of each unique alarm subtype shall be presented.  | M        |
| R3.1.2.6.5 | Where multiple schedule and route adherence violations are being reported for the same vehicle, only the most recent event of each type shall be presented.   | M        |
| R3.1.2.6.6 | Authorized system users shall be able to restrict or change the display reporting thresholds of selected events on their workstation in order to reduce the volume of events being reported during peak operating periods and during service disruptions. | M        |
| R3.1.2.6.7 | System users shall be able to restrict the reporting of schedule and route adherence violations on their workstation and to modify the reporting thresholds in order to control the number of displayed schedule and route adherence violations.          | M        |

### 3.1.2.7 Event Selection

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.1.2.7.1 | The System shall enable authorized system users to quickly locate and select an event.   | M        |
| R3.1.2.7.2 | The System shall provide a convenient mechanism for system users to automatically select the oldest (first received) event in the highest event priority level and the most recent (last received) event in the queue, regardless of the event's priority level. | L        |

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.1.2.7.3 | Upon selection of an event by an authorized system user, the System shall enable the following functions: <ul style="list-style-type: none"> <li>a. View – examine all information concerning the event</li> <li>b. Edit – insert, delete, and modify information concerning the event</li> <li>c. Remove – remove an event from the event listing without responding to the event</li> <li>d. Incident – create and edit an incident report for the event</li> <li>e. Answer – respond to an event requiring a response, including returning a data message and acknowledging alarms</li> <li>f. Show Location – Show the current location of the vehicle associated with the event on the map display</li> <li>g. Transfer – transfer control of the event to another authorized System user.</li> </ul> | M        |
| R3.1.2.7.4 | The System shall manage access to events by multiple system users in order to avoid conflicts and loss of data that may otherwise occur from multiple operations on the same event.  | M        |

### 3.1.2.8 Event Removal

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.1.2.8.1 | Authorized system users shall be able to remove events from the event listing regardless of their current status.   | M        |
| R3.1.2.8.2 | The System shall provide the ability to select multiple events for removal with a single command.   | L        |
| R3.1.2.8.3 | Authorized system users shall be able to specify that all events of a particular type (e.g. data messages of a particular type) be removed with a single command. | L        |
| R3.1.2.8.4 | Removal of emergency alarms shall require additional confirmation from the system user before the request is executed.  | M        |
| R3.1.2.8.5 | Removal of events shall affect only their presentation to system users and shall not affect the historical log, which shall store all events.                     | M        |

### 3.1.2.9 Incidents

The System will need to support the creation, maintenance, tracking, and reporting of incidents relating to event occurrences for vehicles, vehicle operators, and customer service. The final list of incident types will be determined following contract award.

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.1.2.9.1 | The System shall support at least ten (10) different types of incidents.   | M        |
| R3.1.2.9.2 | Each type of incident shall be associated with a unique incident report format that provides the information required for that particular incident type. | M        |

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.1.2.9.3 | The types of incidents and incident reports to be supported shall include, but are not limited to, the following: <ul style="list-style-type: none"> <li>a. General incident</li> <li>b. Maintenance/road call</li> <li>c. Accident</li> <li>d. Missed pullout</li> <li>e. Four (4) spare incident types</li> </ul>  | M        |
| R3.1.2.9.4 | The general information common to all incidents shall include, but not be limited to, the following: <ul style="list-style-type: none"> <li>a. Incident number</li> <li>b. Time and date of the incident</li> <li>c. Incident description</li> <li>d. Vehicle ID</li> <li>e. Route number and direction</li> <li>f. Run/block number</li> <li>g. Vehicle operator name and employee ID</li> <li>h. Incident location</li> <li>i. Responding service supervisor name and employee ID</li> <li>j. Incident status (open/closed)</li> <li>k. System user who opened the incident</li> <li>l. System user who closed the incident</li> <li>m. Time and date the incident was closed</li> </ul> | M        |

### 3.1.2.10 Incident Management

The Owner prefers an approach to incident management that permits multiple events to be linked to a single incident report.

| ID          | Requirement   | Priority |
|-------------|---|----------|
| R3.1.2.10.1 | The System shall support authorized System users in the creation, maintenance, tracking, and distribution of incident reports.  | M        |
| R3.1.2.10.2 | Creation of incident reports shall be triggered automatically for some event types and sub-types (e.g., late pull-out) and on user demand for all other event types and sub-types and for incidents not linked to events.   | M        |
| R3.1.2.10.3 | The System Administrator shall be able to select which events automatically generate an incident report.  | M        |
| R3.1.2.10.4 | The System shall provide functions to enable the System Administrator to specify which events will trigger incident reports and the incident report format to be used, create new incident report formats, edit existing report formats, and integrate new incident report formats into the System. | M        |
| R3.1.2.10.5 | Upon creation of an incident report, the System shall automatically fill in all data for the report that is available to the System, such as vehicle IDs, employee IDs, location, current date, and current time.   | M        |
| R3.1.2.10.6 | Authorized System users shall be able to edit all data fields and fill out any additional data fields defined for the incident report.  | M        |
| R3.1.2.10.7 | Authorized System users shall be able to edit incident report data until the incident is closed.  | M        |

| ID           | Requirement  | Priority |
|--------------|--|----------|
| R3.1.2.10.8  | Supervisors shall have access to existing incident reports, for editing as well as viewing, and shall be able to open new incident reports as desired. | M        |
| R3.1.2.10.9  | Incident reports shall automatically be distributed to appropriate locations on the Owner's LAN/WAN.   | L        |
| R3.1.2.10.10 | Incident report maintenance functions shall be available online without interrupting current System operations.  | M        |

### 3.1.2.11 Service Status (Tabular)

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.1.2.11.1 | The System shall provide information to authorized system users regarding the status of specific routes, schedules, and vehicles within the system users' assigned data partition(s) without the use of geographical maps.   | H        |
| R3.1.2.11.2 | Authorized system users shall be able to filter the data presented using common selection criteria, such as date/time, vehicle, vehicle operator, route, block, and run.   | H        |
| R3.1.2.11.3 | The following types of information shall be provided: <ul style="list-style-type: none"> <li>a. A searchable listing of blocks (vehicle schedules) that provides the scheduled arrival times of vehicles at time points</li> <li>b. All vehicles that are currently in violation of schedule adherence limits with the early/late status (in minutes) and current route and block of each vehicle</li> <li>c. All blocks which are active for the current service day and the current status of each block</li> <li>d. An indication of active blocks that are currently un-served (e.g., due to an overdue operator logon)</li> <li>e. The currently active (logged-on) vehicle operator and vehicle for each block.</li> </ul> | H        |

### 3.1.2.12 Vehicle and Route Selection

The ability to use a combination of both basic and map-based methods to make a selection is considered desirable.

| ID          | Requirement   | Priority |
|-------------|---|----------|
| R3.1.2.12.1 | The System shall enable authorized System users to quickly select sets of vehicles and routes for the purpose of data communications. | M        |
| R3.1.2.12.2 | Vehicle and route selections shall not be restricted according to a System user's assigned data partition(s).                         | M        |

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.1.2.12.3 | <p>The basic methods of vehicle and route selection that shall be supported are as follows:</p> <ul style="list-style-type: none"> <li>a. Select one or more vehicles by specifying vehicle assignment attributes, including employee IDs of the current vehicle operators and current assignment and block numbers.</li> <li>b. The System shall automatically maintain the correlation between vehicles, employee IDs, and run/block numbers based on the current schedule and log-on data received from the vehicle when operators log in.</li> <li>c. Select one or more specified routes by route numbers. Since the set of vehicles associated with a route may change frequently during the service day, the selection of routes shall resolve to the corresponding vehicles only at the time the selection is actually used and not during the selection process itself, which may have occurred at an earlier time.</li> <li>d. Route selections for the data message store and forward function shall pick up new vehicles as they log onto a route during the service day.</li> <li>e. Select all vehicles of a particular service type or types.</li> <li>f. Select one or more vehicles by specifying vehicle IDs.</li> <li>g. The System shall provide a dedicated command for selecting all vehicles (i.e., the System users shall not be required to make manual selections of the vehicles).</li> <li>h. The System shall support re-use of the previous selection without requiring the System user to explicitly re-select the vehicles and routes involved.</li> <li>i. The System user shall be able to name and save vehicle selections for re-use.</li> </ul> | L        |
| R3.1.2.12.4 | Any combination of selection methods shall be applicable interactively in order to construct the desired final list of vehicles and routes.  | L        |
| R3.1.2.12.5 | The system shall automatically filter out duplicate vehicle entries that may occur because of the selection process.   | M        |
| R3.1.2.12.6 | <p>For workstations equipped with geographical map capabilities, the following additional selection methods shall be provided:</p> <ul style="list-style-type: none"> <li>a. Select one or more vehicles and routes that are individually picked from the geographical map display.</li> <li>b. Select all displayed vehicles within a dynamically selected geographical area of the geographical map display.</li> <li>c. A "rubber-band" type of graphical selection shall be supported for selecting the geographical area.</li> <li>d. The System shall generate a list of all vehicles that are currently displayed within the selected area.</li> <li>e. The selected vehicles shall be identified by their vehicle IDs and block numbers.</li> <li>f. Once a list of vehicles is generated, the System user shall be able to add, delete, and modify entries in the list prior to using it.</li> <li>g. Select all displayed routes that pass through a dynamically selected geographical area of the geographical map display.</li> <li>h. The System shall generate a list of all displayed routes that pass through the selected area.</li> <li>i. Once a list of routes is generated, the System user shall be able to add, delete, or modify entries in the list prior to using it.</li> <li>j. Users viewing both revenue and non-revenue vehicles shall be able to specify either or both types of vehicles to be part of the selection.</li> </ul>  | L        |

### 3.1.2.13 Data Messaging

A major goal of the System is to greatly reduce the need for voice communications and to streamline the dispatching function through the extensive use of data messaging between vehicle operators and system users. To this end, the System shall be designed to efficiently support data messaging (i.e., the exchange of text messages).

| ID           | Requirement   | Priority |
|--------------|---|----------|
| R3.1.2.13.1  | The System shall enable authorized system users to send data messages to one or more selected vehicles and routes.  | H        |
| R3.1.2.13.2  | The System shall support custom, free-form data messages and a set of pre-defined data messages.  | H        |
| R3.1.2.13.3  | Pre-defined data messages shall be configurable by authorized system users and shall be available for rapid selection.  | H        |
| R3.1.2.13.4  | The System shall enable system users to specify a response requirement for each data message that is issued.  | H        |
| R3.1.2.13.5  | Response requirement options supported by the System shall include: “no response required”, “acknowledgment of receipt requested”, and “yes/no response requested”.   | H        |
| R3.1.2.13.6  | For messages requiring a response, the System shall request a response from each vehicle operator to whom the data message is directed.   | H        |
| R3.1.2.13.7  | Pre-defined data messages shall each have a pre-defined default response requirement.   | H        |
| R3.1.2.13.8  | The default response requirement for custom messages shall be “no response required”.   | H        |
| R3.1.2.13.9  | The System shall keep track of the status of responses to issued data messages that require a response.   | H        |
| R3.1.2.13.10 | The System shall display to the initiating user, by message, all responses received and those still required but not yet received.  | H        |
| R3.1.2.13.11 | A separate display area shall be used for displaying and managing responses.  | M        |
| R3.1.2.13.12 | Responses shall not be displayed in the event queue.  | M        |
| R3.1.2.13.13 | For each message issued that requires a response, the user shall be able to display a list of the receiving vehicles and their assigned block numbers, an indication of those that have responded and the response received.  | M        |
| R3.1.2.13.14 | Vehicles that have not responded shall be listed at the bottom of the list.   | M        |
| R3.1.2.13.15 | The text of the original data message and the time it was sent shall be displayed at the top of each list.  | H        |
| R3.1.2.13.16 | When multiple message responses are active at the same time, the System shall associate the responses with the proper message as each response is received.   | H        |
| R3.1.2.13.17 | The active messages and the list of responses received for each message shall be preserved when a system user logs off.   | H        |
| R3.1.2.13.18 | When a user logs off, the System shall automatically transfer active messages to a new system user who logs on and takes over the responsibility of the system user who initiated the active messages.<br><br>Alternately, a system user shall have the capability to manually initiate a transfer of the lists to another system user who may not be logged on yet or to whoever assumes the responsibility of the system user who initiated the messages. | M        |
| R3.1.2.13.19 | System users shall be able to choose the message responses to be displayed from a list of active messages for which responses have been required.   | H        |
| R3.1.2.13.20 | System users shall be able to delete a message from the active list even if all of the responses have not been received.  | H        |

### 3.1.3 System Administration Functions

Access to the following system user functions shall be restricted to system administrators.

#### 3.1.3.1 Map Retrieval and Maintenance

| ID          | Requirement   | Priority |
|-------------|---|----------|
| R3.1.3.1.1  | The System shall enable authorized system administrators to manually initiate retrieval of new map data.  | H        |
| R3.1.3.1.2  | The update process shall enable input, validation, and correction of new map data, including addition of map layers, without affecting current System operation and, once complete, it shall permit a controlled and rapid switchover to the new map data.                                | H        |
| R3.1.3.1.3  | A means of switchover to new map data shall be provided that minimizes system disruption while updates are being distributed to all components of the system that require map data, including map enabled workstations.   | H        |
| R3.1.3.1.4  | All distribution shall be automatic and shall not require the system administrator to physically access each component.   | H        |
| R3.1.3.1.5  | The System geographic map shall support all map features of the supplied base map.  | H        |
| R3.1.3.1.6  | Data for route shapes, stops, time-points, and other location base service data shall be created and maintained in the System.  | H        |
| R3.1.3.1.7  | The scheduling sub-system shall use the same base map as the other map-based functions in this system.  | H        |
| R3.1.3.1.8  | The map data required for the System shall be imported from the Owner's ESRI Geographic Information System (GIS) via standard export capabilities, which support ArcInfo/ArcView Shapefile (SHP/SHX/DBF) or geodatabase.  | H        |
| R3.1.3.1.9  | Initialization of the System map data using the Owner-supplied data shall be the responsibility of the Contractor.  | H        |
| R3.1.3.1.10 | The Contractor shall be responsible for all refinements, updates, format conversions and other processing and handling of the map data supplied to them by the Owner as necessary for successful incorporation of the data into the System.   | H        |
| R3.1.3.1.12 | The Contractor shall supply all software, scripts and procedures necessary for successful importation of the Owner map data into the System so that the Owner can perform similar imports in the future without assistance from the Contractor.   | H        |
| R3.1.3.1.13 | All functions necessary for successfully incorporating map data into the System shall be provided as part of the system.  | H        |
| R3.1.3.1.14 | Map maintenance functions shall enable the system administrator to perform regular updates to and replacement of the base map and map overlays used by the System without requiring extensive or complex manual operating procedures and without requiring significant manual data entry. | H        |
| R3.1.3.1.15 | Selective updates of the base map and to any selected overlays shall be possible without re-importing the entire map and all overlays and without loss of prior map edits.  | H        |
| R3.1.3.1.16 | Where minor edits or data entry are required to import map data, such edits, entries, and corrections shall be stored (e.g., as a script) for reapplication in subsequent imports.  | H        |
| R3.1.3.1.17 | The system administrator shall be able to reapply these edits, entries, and corrections on subsequent imports via a minimal set of commands.  | H        |



### 3.1.3.2 In-Vehicle Announcement Data Maintenance

| ID          | Requirement   | Priority |
|-------------|---|----------|
| R3.1.3.2.1  | The System shall enable authorized system administrators to maintain data for all next stop audio announcements and visual displays.  | H        |
| R3.1.3.2.2  | Audio and visual announcement messages shall be fully managed within the System announcement maintenance functions.   | H        |
| R3.1.3.2.3  | The use of numeric codes for messages that must then be manually coordinated with separate, external annunciator programming facilities is not acceptable.  | H        |
| R3.1.3.2.4  | Capacity for at least 50 audio and 50 visual announcements per route shall be provided.   | H        |
| R3.1.3.2.5  | The announcement maintenance functions shall include functions to create, edit and delete audio and visual announcements and their associated triggers and text descriptions.   | H        |
| R3.1.3.2.6  | For audio announcements, a method shall be provided for specifying output options of “interior”, “exterior”, and “both”.  | H        |
| R3.1.3.2.7  | A method for synchronizing an audio and visual message together via the same trigger, or by other means, shall be provided.   | H        |
| R3.1.3.2.8  | The maintenance facility shall enable prioritization of announcements, thereby enabling higher priority announcements to interrupt lower priority announcements when triggers overlap.  | H        |
| R3.1.3.2.9  | Triggering of automatic audio and visual announcements shall include, but not be limited to, the following methods: <ul style="list-style-type: none"> <li>a. Approaches to scheduled stops and time-points – Triggers that occur at user-specified distance prior to arrivals at user-specified stops and locations within scheduled trips</li> <li>b. Time of day</li> <li>c. Elapsed time – triggers that occur at a user-specified amount of time from the start of a user-specified trip</li> <li>d. Door open event</li> <li>e. Door close event</li> </ul> | M        |
| R3.1.3.2.10 | Support for manual (i.e., vehicle operator-triggered) announcements shall be provided.  | M        |
| R3.1.3.2.11 | A simple means of cutover to new announcement data sets shall be provided that coordinates with other changes, such as route changes, that may be pending.  | M        |
| R3.1.3.2.12 | The distribution of announcement data shall be according to the requirements specified for bulk data exchange.  | M        |

### 3.1.3.3 System Configuration Monitoring and Control

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.1.3.3.1 | The System shall provide the system administrator with the ability to review and revise the System configuration and configuration parameters. | M        |
| R3.1.3.3.2 | The ability to monitor the status of all System components and processes shall be provided.  | M        |

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.1.3.3.3 | Functions to control system performance monitoring and to display and analyze server processor resource utilizations shall be provided.  | M        |
| R3.1.3.3.4 | Control operations that shall be supported shall include, but not be limited to, server and LAN administration (Contractor provided components only), and management of interfaces and control of System components. | M        |
| R3.1.3.3.5 | The system administrator shall be able to add or remove fleets from the list of active fleets.   | M        |
| R3.1.3.3.6 | The system administrator shall be able to configure a new fleet to acquire fleet location data from this System or from a vehicle location text file that is periodically updated.                                   | M        |

#### 3.1.3.4 User Access Administration

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.1.3.4.1 | The system administrator shall be able to add, modify, and delete user accounts.                     | M        |
| R3.1.3.4.2 | The system administrator shall be able to add, modify, and delete user groups.                       | M        |
| R3.1.3.4.3 | The system administrator shall be able to add users to or remove users from one or more user groups. | M        |
| R3.1.3.4.4 | The system administrator shall be able to assign privileges and permissions to user groups.          | M        |

#### 3.1.4 Report Production Functions

The system shall be capable of producing a set of pre-defined and user-defined ad hoc reports. System reporting requirements are defined in Section 3.6.

#### 3.1.5 Fixed Route Scheduling Functions

The System will include the capability to build, maintain, and delete fixed route schedules and route information.

The Owner identifies service using a run/block identifier where the assignment (run) number identifies the work performed by a bus operator and the block number identifies the work performed by a vehicle. Currently, holiday operation schedules are the same as a weekend schedule, but specific holiday schedules may be implemented in the future.

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.1.5.1 | The System shall include the capability to build, maintain, and delete fixed route schedules and route information.          | M        |
| R3.1.5.2 | The System shall allow the user to enter the route on a map based user interface.  | M        |
| R3.1.5.3 | The System shall allow the user to assign scheduled times to each pull-out, pull-in, stop, and waypoint on the route.        | M        |
| R3.1.5.4 | The System shall export all schedule data to the Owner's website in the TriMet schedule data format specified in Appendix C. | M        |

| ID        | Requirement  | Priority |
|-----------|--|----------|
| R3.1.5.5  | The schedule of bus trips for each service day shall be automatically selected by the System based on the date and a calendar of schedule types applicable to each day.      | M        |
| R3.1.5.6  | The type of schedule applicable to each day shall be definable by the Owner in advance for an entire calendar year.  | M        |
| R3.1.5.7  | The Owner shall be able to define and change the dates on which new schedule updates are to be used by the System.   | M        |
| R3.1.5.8  | The System shall support at least eight (8) types of Owner schedules: weekday, Saturday, and 6 future schedule types.  | M        |
| R3.1.5.9  | The System shall support service days that cover time periods over 24 hours in duration and that end at the time of the last pull-in.  | M        |
| R3.1.5.10 | All System displays, reports, calculations, vehicle operator log-ins, System nomenclature, and other System aspects shall utilize the Owner convention of run/block numbers. | M        |
| R3.1.5.11 | The System shall support trip directions of Inbound, Outbound, North (N), South (S), East (E), and West (W).   | M        |

### 3.1.6 Service Management Functions

Service Management Functions allow users to enter temporary deviations from routes and schedules.

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.1.6.1 | The System shall provide a set of service management functions and features to permit authorized system users to make changes to the scheduled service.  | M        |
| R3.1.6.2 | The service management functions shall include, but not be limited to, the following capabilities:<br>a. Define and modify detours, including which service is affected by the detour and the times/dates that each detour is to be in effect.<br>b. Add, modify, or cancel service by adding, modifying, or deleting blocks or portions of blocks.<br>c. Defining unscheduled turn-backs.<br>d. Performing vehicle and vehicle operator replacements. | M        |
| R3.1.6.3 | The System shall enable authorized dispatchers to monitor the status of scheduled relief operators for vehicle operators.  | M        |
| R3.1.6.4 | A complete schedule of relief operators for the service day shall be provided that shows the status of each scheduled relief.  | M        |

### 3.1.7 Schedule and Route Adherence Monitoring

The Owner prefers a system which minimizes the use of radio communications for the transmission of vehicle data. A system which calculates schedule and route adherence at the dispatch center and on-board each fixed-route revenue vehicle and transmits only the GPS data from the vehicles is preferred. Note that some reporting locations, such as layover areas, are not discrete points in space but rather are areas near a defined point.

| ID        | Requirement  | Priority |
|-----------|--|----------|
| R3.1.7.1  | The System shall accurately monitor the schedule and route adherence of all AVL-equipped fixed-route revenue buses operating on defined schedules.   | M        |
| R3.1.7.2  | The System shall calculate schedule adherence in terms of the number of minutes and seconds early or late, but only the number of minutes early or late shall be displayed.  | M        |
| R3.1.7.3  | Schedule adherence messages and other indications presented to System users shall include the number of minutes of deviation from the schedule.  | M        |
| R3.1.7.4  | Schedule adherence shall be calculated for each defined schedule adherence reporting location (time points and terminal locations) and accurately estimated between defined schedule adherence reporting locations.                              | M        |
| R3.1.7.5  | Schedule adherence shall be based on scheduled departure time from a reporting location or scheduled arrival time, as configured by the system administrator.  | M        |
| R3.1.7.6  | The system administrator shall be able to define which reporting locations are to be treated as departure locations, which reporting locations are to be treated as arrival locations, and which are to be both arrival and departure locations. | M        |
| R3.1.7.7  | Actual reporting location departures and arrivals shall be determined by the System to an accuracy of $\pm 15$ seconds, regardless of whether the vehicle stops at the reporting location or passes the reporting location without stopping.     | M        |
| R3.1.7.8  | The System shall allow a vehicle to move within a defined distance of a reporting location without considering the vehicle to have departed the reporting location.  | M        |
| R3.1.7.9  | Arrival of a vehicle to within the defined distance from a reporting location shall be considered as arrival at the reporting location.  | M        |
| R3.1.7.10 | The system administrator shall be able to define the distance applicable to each reporting location on a location by location basis.   | M        |
| R3.1.7.11 | All calculated schedule and route deviations reported by the System shall be displayed to the System users responsible for the buses with the schedule and/or route deviations, in accordance with defined reporting thresholds.                 | M        |
| R3.1.7.12 | The threshold values for declaring a vehicle to be off-schedule or off-route shall be adjustable by the system administrator.  | M        |
| R3.1.7.13 | Initially, schedule deviations over one minute early and equal to or over two minutes late shall be treated and alarmed as schedule deviations.  | M        |
| R3.1.7.14 | Route deviation limits from the scheduled bus route shall be assignable as a system-wide value and on a route-by-route exception basis so that paratransit routes may have wider route deviation thresholds than fixed routes.                   | M        |
| R3.1.7.15 | Route adherence shall only be calculated during revenue movements of the bus.  | M        |
| R3.1.7.16 | Route adherence shall be determined by comparison of the bus' actual location during revenue movement with the stored definition of the revenue trip that the bus is scheduled to perform.   | M        |
| R3.1.7.17 | Route deviations that shall be detected by the System shall include the detection of unscheduled turn-backs.   | M        |

| ID        | Requirement   | Priority |
|-----------|---|----------|
| R3.1.7.18 | The System shall be able to detect and alarm when a revenue service bus turns around before the end of a scheduled trip and proceeds along the route in the opposite direction.   | M        |
| R3.1.7.19 | Following a turn-back, the System shall automatically determine the vehicle's new geographic location, the vehicle's direction, and the vehicle's schedule.   | M        |
| R3.1.7.20 | Schedule and route adherence shall not be calculated while a bus is deadheading to and from a revenue service portion of a route.   | M        |
| R3.1.7.21 | Because not all buses will follow identical paths when deadheading between the same two points and not all deadheads begin and end at the same points on a route, the System shall support variations in the paths taken by deadheading vehicles for each route and shall support buses deadheading to and from different points along a route. | M        |
| R3.1.7.22 | The schedule and route deviation status of each bus displayed on the Geographical Map display shall be indicated via color-coding of the vehicle symbol, or by similar suitable means.  | M        |

### 3.1.8 Base Monitoring (Optional)

The base monitoring function is intended to provide monitoring of activity in and around the primary bases and terminals for the buses. This monitoring of departures only applies to the fixed route buses. All buses currently depart from one location, but the system should accommodate future operations where buses depart from multiple locations.

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.1.8.1 | The System shall monitor the times that all the Owner buses are scheduled to leave the Base and other defined departure locations for a revenue service trip.   | M        |
| R3.1.8.2 | Any scheduled pull-out that has not occurred within a system administrator adjustable time period of the scheduled departure time shall be reported to the responsible dispatcher via an event message.                   | M        |
| R3.1.8.3 | The actual base departure times of all scheduled pull-outs shall be monitored and logged by the System, regardless of whether the bus departed early, on-time, or late.   | M        |
| R3.1.8.4 | The System shall support cases where buses may enter and leave a site via multiple entrances/exits.   | M        |
| R3.1.8.5 | The System shall support cases where there are up to ten (10), physically separate areas from which buses can leave for a revenue service trip.   | M        |
| R3.1.8.6 | The System shall support cases where a bus moves within the base location before leaving for revenue service.   | M        |
| R3.1.8.7 | The System shall monitor the log-in status of MDT-equipped vehicles that are operating outside of the base and other defined departure locations and are not logged-in.   | M        |
| R3.1.8.8 | If the System detects that an MDT equipped vehicle is outside of the base and other defined departure location boundaries and is not logged-in, the vehicle operator shall be prompted to logon via a message on the MDT. | M        |

| ID        | Requirement   | Priority |
|-----------|---|----------|
| R3.1.8.9  | The vehicle operators may logon with any valid revenue or non-revenue logon.  | M        |
| R3.1.8.10 | If the vehicle operator fails to logon within a system administrator-defined time period, dispatch center personnel shall be notified that the vehicle is not logged-in via an event message. | M        |
| R3.1.8.11 | Dispatch center personnel shall be able to logon and logoff a vehicle via the System.   | M        |
| R3.1.8.12 | Dispatch center personnel shall be able to display roster information regarding vehicle operator assignments and regarding scheduled and actual vehicle operator logon and logoff times.      | M        |

### 3.1.9 Revenue Vehicle Functions

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.1.9.1 | The Contractor shall furnish the equipment to perform the on-board vehicle processing as required to support the System functions and capabilities specified.   | H        |
| R3.1.9.2 | The furnished equipment shall interface with the System, other on-board devices, control data radio communications, and perform other tasks required by the Contractor's design and the specific devices installed on each vehicle. | H        |

#### 3.1.9.1 Vehicle Location Reporting

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.1.9.1.1 | All location reporting messages shall contain all of the data elements of the RMC message of the NMEA-0183 standard for GPS/Transit data.                                    | H        |
| R3.1.9.1.2 | Current vehicle location data shall always be reported as part of all data messages.   | H        |
| R3.1.9.1.3 | Location data reported to the System shall include an indication whether the location data is of sufficient quality for it to be used for indicating the vehicle's position. | H        |
| R3.1.9.1.4 | All invalid and low quality location data shall be indicated as such and shall not be used by the System.  | H        |
| R3.1.9.1.5 | The vehicle locations shall be based upon on-board GPS equipment and any supplemental location inputs (e.g.: dead reckoning) implemented to meet the specified requirements. | H        |

#### 3.1.9.2 Operator Logon/Logoff

The Operator Logon function is intended to verify that the operator matches the assigned operator for the route assigned to a given vehicle. Paratransit vehicles may be assigned to routes by run/block numbers or simply route numbers.

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.1.9.2.1 | Fixed route vehicle operators shall be required to logon with the run/block number and employee ID. | L        |

| ID          | Requirement   | Priority |
|-------------|---|----------|
| R3.1.9.2.2  | Paratransit service vehicle operators shall be required to logon with the route number and employee ID.   | L        |
| R3.1.9.2.3  | For non-revenue vehicles equipped with MDTs, and revenue vehicles in non-revenue service, vehicle operators shall be required to logon with a non-revenue service number and employee ID.                                     | L        |
| R3.1.9.2.4  | The System shall verify that all logon data is valid before accepting the logon.  | L        |
| R3.1.9.2.5  | On non-revenue vehicles, the System shall verify that the non-revenue service number is valid.  | L        |
| R3.1.9.2.6  | On all vehicles, the system shall verify that the entered employee ID is a valid number in the current list of vehicle operators, and that the same vehicle operator is not already logged-on to another vehicle.             | L        |
| R3.1.9.2.7  | Logon validity checks shall be performed on-board the vehicle so that the time required to perform the validity checking is minimized.  | L        |
| R3.1.9.2.8  | Invalid logon attempts shall be rejected.   | L        |
| R3.1.9.2.9  | Logon attempts that fail any of the specified validity checks shall be reported to the vehicle operator along with an explanation of the specific problem encountered.  | L        |
| R3.1.9.2.10 | After three consecutive invalid logon attempts, the System shall log an event that indicates all relevant information about the invalid logon attempt, including the logon data being entered, vehicle ID, and date and time. | L        |
| R3.1.9.2.11 | All valid logons and logoffs shall be logged as events that indicate all relevant information about the logon and logoff, including the employee ID, the entered logon data, and date and time.                               | L        |
| R3.1.9.2.12 | A successful logon shall trigger the delivery of any relevant stored data messages to the vehicle.  | L        |
| R3.1.9.2.13 | The System shall verify that revenue vehicle operator's logon in time to begin their runs on schedule.  | L        |
| R3.1.9.2.14 | The System shall issue an event message to the proper dispatch center personnel responsible for the affected route if a vehicle operator logon is late by more than a system administrator-adjustable time period.            | L        |
| R3.1.9.2.15 | The permissible login time period shall initially be set to five minutes before the scheduled departure time and shall be adjustable from 15 minutes before to at least 5 minutes after the scheduled time of departure.      | L        |
| R3.1.9.2.16 | If a vehicle operator fails to logon prior to leaving the base, the System shall issue an audible alarm to the vehicle operator and prompt the vehicle operator to logon.   | L        |
| R3.1.9.2.17 | System users shall be immediately notified via an alarm if a vehicle operator fails to logon prior to leaving the base.   | L        |
| R3.1.9.2.18 | Successful logon shall not be required in order to use any of the vehicle communications and emergency alarm functions of the on-board System equipment.  | L        |

### 3.1.9.3 Data Messaging

Data messaging will be used for communication between dispatchers and vehicle operators, and to communicate transfer information between vehicle operators on fixed-route services.

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.1.9.3.1  | The System shall enable vehicle operators to send predefined text data messages to System users with a minimum of interaction.   | M        |
| R3.1.9.3.2  | The System on-board equipment shall support at least 100 pre-defined messages, per service type (fixed route, Paratransit, and non-revenue), each of at least 30 characters in length.                                       | L        |
| R3.1.9.3.3  | The System shall allow the system administrator to define and revise a set of predefined messages for each service type and to schedule the transfer of the revised messages to all vehicles of the associated service type. | L        |
| R3.1.9.3.4  | Vehicle operators shall be able to review messages recently received from system users at any time with a minimum of interaction.  | M        |
| R3.1.9.3.5  | The System on-board equipment shall be capable of retaining at least the last 10 received messages for vehicle operator review.  | M        |
| R3.1.9.3.6  | The received messages shall be ordered chronologically with the most recently received message presented first.  | M        |
| R3.1.9.3.7  | Message lengths of up to 250 characters shall be supported.  | M        |
| R3.1.9.3.8  | Vehicle operators shall receive both audible and visual indications when new messages are received.  | M        |
| R3.1.9.3.9  | Audible indications of the receipt of a new message shall be non-obtrusive and non-repetitive.   | L        |
| R3.1.9.3.10 | Means for scrolling through a message when the message text is longer than what can be displayed at once on the MDT shall be provided.   | M        |
| R3.1.9.3.11 | Vehicle operators shall be able to selectively view, save, and delete messages received from the System.   | M        |
| R3.1.9.3.12 | Messages requiring a response shall be clearly indicated to the vehicle operators.   | M        |
| R3.1.9.3.13 | Vehicle operators shall be able to respond with a minimum of interaction.  | M        |
| R3.1.9.3.14 | The System shall support message responses of “acknowledge”, “yes”, and “no”.  | M        |
| R3.1.9.3.15 | Message responses shall be routed to the requesting system users.  | M        |

#### 3.1.9.4 MDT Audible Annunciation

Audible annunciation is required to alert vehicle operators that a message has been received.

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.1.9.4.1 | The on-board vehicle equipment shall produce audible tones when a new data message is displayed on the MDT display.   | M        |
| R3.1.9.4.2 | Unique and distinct tones shall be produced for each of the following conditions: <ul style="list-style-type: none"> <li>• Display of a message sent by a system user</li> <li>• Display of a message sent by the System</li> <li>• Display of a message produced by the MDT</li> </ul> | M        |
| R3.1.9.4.3 | The tones used for each of the specified conditions and whether the tones are repeated, non-repeated, or continuous shall be subject to the Owner’s approval.   | L        |



### 3.1.9.5 On-Board next Stop Audio & Visual Announcements

The system is not required to control bus head signs, but systems capable of controlling head signs are acceptable.

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.1.9.5.1  | The System shall provide automatic next stop audio and visual display announcements to passengers on board revenue vehicles.   | H        |
| R3.1.9.5.2  | This function shall support next stop announcements as well as annunciation of major intersections, key transfer points, promotional information, public service information, operator messages, and advertising.                | H        |
| R3.1.9.5.3  | Written scripts for the initially required announcement messages and the locations where announcements are to be made will be supplied by the Owner for recording and implementation by the Contractor.                          | L        |
| R3.1.9.5.4  | The Contractor shall initialize the audio recordings, visual display messages, and announcement trigger points to support the Owner-provided locations and announcements.  | H        |
| R3.1.9.5.5  | Configuration of audio announcements and visual displays shall permit triggering of specific messages based upon a variety of conditions.  | H        |
| R3.1.9.5.6  | The capability to randomize playing of timed announcements, such as advertising and public service announcements, is preferred.  | L        |
| R3.1.9.5.7  | The System shall include the functional capability for the Owner to revise the initial, Contractor-supplied messages and to record additional messages as its services and routes change.  | H        |
| R3.1.9.5.8  | All programming features of the supplied maintenance functions shall be fully supported by the in-vehicle announcement and display capabilities.   | H        |
| R3.1.9.5.9  | The system shall provide a method for installing announcement and display updates on vehicles that does not require direct programming of each announcement device via memory cards and/or other manual methods.                 | H        |
| R3.1.9.5.10 | The System shall not issue next stop messages when the vehicle is off-route.   | H        |
| R3.1.9.5.11 | Audio levels shall be controllable by the vehicle operator within a usable audio range.  | H        |
| R3.1.9.5.12 | The vehicle operator shall have the capability of overriding the automatic initiation of audio announcements and visual displays and instead manually select from a menu of predefined messages for announcements to passengers. | L        |
| R3.1.9.5.13 | The override of announcements and displays shall be reported as an event.  | L        |
| R3.1.9.5.14 | The System shall include a means of coordinating visual announcements with corresponding audio announcements.  | H        |

### 3.1.9.6 Mechanical Alarms (Optional)

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.1.9.6.1 | The System shall interface to vehicle warning and failure alarm systems and generate an appropriate mechanical alarm event to system users. | L        |
| R3.1.9.6.2 | A minimum of four different mechanical alarm conditions shall be supported.   | L        |

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.1.9.6.3 | The conditions that can be alarmed shall include any warning and failure condition for which a discrete status signal is available. | L        |
| R3.1.9.6.4 | The specific alarms to be interfaced shall be determined following Contract Award.  | L        |

### 3.1.10 Non-Revenue Vehicle Functions

#### 3.1.10.1 Supervisory and Maintenance Vehicles

| ID          | Requirement   | Priority |
|-------------|---|----------|
| R3.1.10.1.1 | The System shall support data communications with designated supervisory and snow plow vehicles.  | M        |
| R3.1.10.1.2 | The capabilities provided for designated non-revenue vehicles shall include functions identified for the revenue vehicles for logon, logoff and vehicle location reporting. | M        |
| R3.1.10.1.3 | All equipment required to meet these requirements shall be provided under this contract, including MDTs if proposed as part of the solution.                                | M        |
| R3.1.10.1.4 | The vehicle locations shall be displayed on the Owner route and service area map.   | M        |

#### 3.1.10.2 Snow Plows

The Owner desires that the System monitor and record what roadways have been plowed and/or treated by the transit company snow plows. Status contacts indicating plow position (up/down) and sand or chemical application will be wired from the vehicles to the Contractor supplied status input monitor.

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.1.10.2.1 | The System shall support data communications with designated snow plow and maintenance vehicles.   | M        |
| R3.1.10.2.2 | The capabilities provided for designated non-revenue vehicles shall include functions identified for the revenue vehicles for logon, logoff, data messaging, and vehicle location reporting. | M        |
| R3.1.10.2.3 | All equipment required for snow plow equipment monitoring shall be provided under this contract, including MDTs if proposed as part of the solution.   | M        |
| R3.1.10.2.4 | Monitoring for a minimum of four different equipment status conditions shall be supported.   | L        |
| R3.1.10.2.5 | The specific equipment status indicators to be interfaced shall be determined following Contract Award.  | L        |
| R3.1.10.2.6 | The vehicle locations shall be displayed on the Owner route and service area map.  | M        |

## 3.2 External Interface Requirements

This section covers the requirements that define logical and functional characteristics of the interfaces between the System software, System components, and system users. This includes users, the hardware on which the System runs, supporting software, communications interfaces, and protocols for external system interfaces.

### 3.2.1 General User Interface Requirements

The following features shall be included in the System user interface. Alternatives may be offered but must be functionally equivalent to the features specified.

#### 3.2.1.1 Windows

The Owner prefers a system which supports a Windows XP operating system with a thick client or a Windows Explorer based thin client.

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.2.1.1.1 | The System shall support the simultaneous display of at least eight windows on each screen of a workstation.   | M        |
| R3.2.1.1.2 | The windows shall be individually selectable by the user using the keyboard and the cursor positioning device, with the currently selected window being the focus for all user input.  | M        |
| R3.2.1.1.3 | The windows shall be re-configurable by the user as follows:<br>a. Quickly displayed in overlapping and tiled configurations at the user's option<br>b. Easily resized to any dimension up to the full dimensions of the screen<br>c. Easily moveable to any position on the screen, including between screens on a multi-screen workstation<br>d. Quickly reduced to an icon and subsequently restored to the previously configured size and position | M        |
| R3.2.1.1.4 | Window configurations (including window locations, window sizes, and window content configurations) shall be defined on a per-user basis, and shall be retained between user sessions.   | M        |

#### 3.2.1.2 Highlighting

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.2.1.2.1 | Highlighting techniques shall direct System users to critical information on displays.   | L        |
| R3.2.1.2.2 | The display attributes of color, color intensity, blinking, shading, and appended letters, numbers or symbols shall be provided.   | L        |
| R3.2.1.2.3 | Display attributes shall be used to highlight and distinguish event queue entries, alarms, data entry locations, allowable functions, important operational conditions (such as schedule and route deviations), error conditions, and other information. | L        |
| R3.2.1.2.4 | The use of highlighting shall be consistent throughout all displays of the System.   | L        |

### 3.2.1.3 System User Guidance

Standard help and user guidance features are desired. The following features are required.

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.2.1.3.1 | The System shall provide a means for displaying system user guidance messages.  | M        |
| R3.2.1.3.2 | System user guidance messages shall be clearly understandable English text and shall not require the use of a reference document for interpretation.  | M        |
| R3.2.1.3.3 | Critical actions initiated by the system user, such as a deletion, shall be performed only after a warning message and a request for confirmation are issued to the initiating user and the confirmation of the intended action is received from the initiating user. | M        |
| R3.2.1.3.4 | Pop-up user guidance messages shall not require the user to select or move them in order to read their contents.  | M        |
| R3.2.1.3.5 | The System shall respond to all system user input actions indicating whether the action was accepted, was not accepted, or is pending.  | M        |
| R3.2.1.3.6 | For multi-step procedures, the System shall provide feedback at each step.  | M        |
| R3.2.1.3.7 | User guidance shall include text messages, color changes, displayed symbols, or blinking.   | M        |

### 3.2.1.4 Cursor Position Selection

Standard Windows conventions for cursor positioning are desired.

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.2.1.4.1 | Multiple methods of rapid and convenient cursor positioning shall be provided, including forward and backward tab keys, a direct cursor positioning device (e.g.: mouse), and cursor control keys. | L        |
| R3.2.1.4.2 | Cursor positioning techniques shall be consistent for all displays.  | L        |
| R3.2.1.4.3 | Tab stops that are not displayed shall be placed at the first character of enterable data fields, at selection fields, and at other cursor targets.  | L        |
| R3.2.1.4.4 | Cursor targets on displays shall be sufficiently large to permit rapid selection of the target and shall be sufficiently spaced apart to minimize the possibility of incorrect target selections.  | L        |

### 3.2.1.5 Function and Display Selection

It is of utmost importance that the System user interface be designed to allow all System user actions to be completed as quickly, efficiently, and reliably as possible.

The System user interface must be designed to be user-friendly and to minimize the System user actions and time required to complete display requests, initiate communications, select from a list of entries, perform data entry, and initiate other System user functions.

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.2.1.5.1 | Menu bars of the most commonly required displays and functions shall be available to system users at all times.   | L        |
| R3.2.1.5.2 | System users shall be able to initiate the most common functions and display requests at any time by a variety of means, depending on the system user's preference.                               | L        |
| R3.2.1.5.3 | Function selection capabilities shall include the selection of items from menu bars, pop-up menus, use of function keys, use of a mouse (or other cursor positioning device), and keyboard entry. | L        |
| R3.2.1.5.4 | Where a function or action requires system user selection from a list of multiple options and it is reasonable to define a default option, default selections shall be defined.                   | L        |

### 3.2.1.6 Data Entry

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.2.1.6.1  | All enterable data fields shall be clearly identified as to their purpose.   | L        |
| R3.2.1.6.2  | All enterable data fields shall be clearly distinguished as enterable fields.  | L        |
| R3.2.1.6.3  | If only a portion of a data value needs to be changed, only that portion of the value shall need to be entered.  | L        |
| R3.2.1.6.4  | The system user will initiate data entry by selecting the field to be entered on a display.  | L        |
| R3.2.1.6.5  | The field selected by a system user shall be indicated.  | L        |
| R3.2.1.6.6  | An authorization feature shall determine if proper authorization exists for the system user requesting data entry.   | H        |
| R3.2.1.6.7  | The System shall verify system user entries.   | H        |
| R3.2.1.6.8  | Invalid entries shall be rejected and reported to the system user as user guidance messages.   | M        |
| R3.2.1.6.9  | Full-page data entry shall be provided that allows users to make multiple data entries before requesting that the data be entered into the database.   | L        |
| R3.2.1.6.10 | All valid entries shall be accepted and only invalid entries rejected, unless a System function requires all entries be correct.   | L        |
| R3.2.1.6.11 | If an entry is incorrect and other entries are correct, the user shall not be required to re-enter data in fields containing valid values.   | L        |
| R3.2.1.6.12 | The amount of data that system users are required to enter shall be minimal.   | L        |
| R3.2.1.6.13 | The System shall insert any data that is already known (e.g., date, time, system user identification, vehicle information, and vehicle operator information) and provide default values where appropriate. | L        |
| R3.2.1.6.14 | System users shall be able to override any data automatically inserted by the System.  | L        |
| R3.2.1.6.15 | When data entry of a field is limited to a known set of valid responses, the list of valid responses shall be presented to the user in the form of a scrollable list.                                      | L        |
| R3.2.1.6.16 | The user shall be able to select the desired entry from the list of valid responses.   | L        |

| ID          | Requirement   | Priority |
|-------------|---|----------|
| R3.2.1.6.17 | In cases where the list of possible entries is extensive and direct manual data entry may be faster, system users shall have the option to enter the data manually. | L        |
| R3.2.1.6.18 | The user shall be able to end data entry at any time by selecting “Cancel” or requesting a different display or window.   | L        |
| R3.2.1.6.19 | Cancellation shall cause the process to be terminated and the data value shall remain unchanged.  | L        |

### 3.2.2 Dispatch User Interface

The System shall provide functions to support authorized System users as specified in the following sections.

#### 3.2.2.1 Geographical Map Display

This section identifies specific features of the geographical map display that shall be provided with the System.

The Owner will supply the Contractor with a GIS base map of the service area for use by the System geographical map displays. The map data includes the street network, street names and address range information for the road segments in the Owner service territory and portions of surrounding counties. Also contained in this data set are landmarks, such as schools, parks, fire departments, hospitals, and bodies of water.

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.2.2.1.1 | A geographical map display shall be provided that supports basic functional requirements for vehicle location status tracking, vehicle and route selection, and other supplied functions that require the use of a geographical map.  | H        |
| R3.2.2.1.2 | The geographical map display shall present a map of the Owner’s fixed route bus service area and paratransit service area as well as the surrounding Lancaster county.  | H        |
| R3.2.2.1.3 | Map overlay levels pertaining to the Owner that are contained in the Owner’s GIS database shall be imported into the System by the Contractor and defined on the System geographical map display.   | H        |
| R3.2.2.1.4 | Map overlays shall include, but not be limited to, the Owner bus routes, the Owner landmarks for fixed route service, paratransit service landmarks and important locations, service area and service call boundaries, other service provider’s routes, and other defined Owner-specific information. | H        |
| R3.2.2.1.5 | System users shall be able to selectively overlay and selectively remove this overlay data.   | H        |
| R3.2.2.1.6 | At least ten (10) geographical map overlay layers shall be supported by the System.   | H        |
| R3.2.2.1.7 | Each Owner route shall be displayable in a different color to aid in distinguishing different routes and types of routes.   | H        |
| R3.2.2.1.8 | The System shall provide specific display interaction capabilities in order to enable system users to efficiently interact with the System geographical maps.   | H        |

##### 3.2.2.1.1 Map Views

The Owner prefers designs that allow system users to select the area of the territory to be displayed in the geographical display window by positioning the cursor within the navigation aid window and selecting the area of interest, herein referred to as views.

| ID           | Requirement   | Priority |
|--------------|---|----------|
| R3.2.2.1.1.1 | System users shall be able to set up particular views of the territory on the map display and store them for future recall.   | L        |
| R3.2.2.1.1.2 | The ability to define, store, and retrieve up to 30 specific views of portions of the territory shall be supported.   | L        |
| R3.2.2.1.1.3 | Each of the views shall be uniquely identified and rapidly displayable by the system user.  | L        |
| R3.2.2.1.1.4 | Each stored view shall include a definition of the area being displayed, scale/zoom level, routes and vehicles to be displayed, center point of the display, and other parameters that define what information is displayed and how it is displayed.  | L        |
| R3.2.2.1.1.5 | When a stored view is selected, it shall be displayed as defined in the setup parameters for the particular view.   | L        |
| R3.2.2.1.1.6 | All map functions, controls, and real-time vehicle updates shall be active when stored views are being displayed.   | L        |
| R3.2.2.1.1.7 | An overview of the Owner's entire service territory shall be presented in a window located in the lower right corner of the screen to serve as a navigation aid for System users when only a selected portion of the entire territory is being displayed in the window containing the geographical map display. | L        |
| R3.2.2.1.1.8 | The area currently being displayed by the System user shall be outlined on the overview navigation aid display to help orient System users as to the portion of the territory being displayed in the geographical map display window.   | L        |

### 3.2.2.1.2 Map Attributes

| ID           | Requirement  | Priority |
|--------------|--|----------|
| R3.2.2.1.2.1 | The geographical map display shall support a variety of map attributes, including displaying all streets, highways, prominent geographical features (e.g., rivers, major bodies of water, etc.), important landmarks (bridges, airports, transit centers, the Owner's base, important buildings, etc.), bus routes, transfer points, and interconnection points with other service providers, including rail lines and stations. | H        |
| R3.2.2.1.2.2 | The major bodies of water shall be displayed as areas of solid blue or cyan on the geographical map display.   | H        |

### 3.2.2.1.3 Vehicle Overlays

| ID           | Requirement   | Priority |
|--------------|---|----------|
| R3.2.2.1.3.1 | The System shall be capable of displaying the locations of all of the vehicles in a System user-selected fleet at the same time.                      | H        |
| R3.2.2.1.3.2 | The real-time locations of all AVL-equipped vehicles shall be indicated by special vehicle symbols that are overlaid on the geographical map display. | H        |
| R3.2.2.1.3.3 | Each vehicle's displayed location shall be based on the last valid location reported by the vehicle.  | H        |
| R3.2.2.1.3.4 | The vehicle symbols shall be approved by the Owner and shall be easily modified by the Owner.   | H        |
| R3.2.2.1.3.5 | The System shall support the concurrent use of fifteen (15) distinctive vehicle symbols to indicate the different Owner vehicle service types.        | H        |
| R3.2.2.1.3.6 | A vehicle identifier shall be displayed adjacent to, or within, each vehicle symbol.  | H        |

| ID            | Requirement  | Priority |
|---------------|--|----------|
| R3.2.2.1.3.7  | Vehicle identifiers shall uniquely identify each vehicle.  | H        |
| R3.2.2.1.3.8  | The vehicle identifier used by the system shall be configurable by the system user.  | H        |
| R3.2.2.1.3.9  | The possible vehicle identifiers shall include run/block number, route number, vehicle ID, and vehicle operator employee ID.   | H        |
| R3.2.2.1.3.10 | The System shall enable different vehicle identifiers to be used for different service types; for example, fixed route vehicles may be identified by run/block number and paratransit vehicles may be identified by route numbers.   | H        |
| R3.2.2.1.3.11 | Vehicle symbols shall clearly show the vehicle type, state, and status using combinations of symbol colors and shapes and, if necessary, text.   | H        |
| R3.2.2.1.3.12 | System users shall be able to dynamically display all AVL equipped vehicles, those vehicles that pertain to selected service types, or those that belong to a specific fleet.  | H        |
| R3.2.2.1.3.13 | System users shall be able to call up additional information pertaining to a vehicle by selecting the vehicle's symbol on the display.   | H        |
| R3.2.2.1.3.14 | Additional vehicle information shall be displayed in a pop-up window.  | H        |
| R3.2.2.1.3.15 | The vehicle symbol shall indicate the status of each vehicle including: <ul style="list-style-type: none"> <li>a. Schedule status (early, on-schedule, or late) (fixed route buses only)</li> <li>b. Route status (on or off-route) (fixed route buses only)</li> <li>c. Type of vehicle (fixed route bus, paratransit, service supervisor vehicle, road service vehicle, etc.)</li> <li>d. Revenue status (in/out of revenue service) (revenue vehicles only)</li> <li>e. Direction of travel</li> <li>f. Communications status (loss of data radio communications, loss of GPS)</li> </ul> | H        |
| R3.2.2.1.3.16 | Combinations of symbols, colors, and shapes may be used to distinguish the status of each vehicle.   | H        |
| R3.2.2.1.3.17 | System users shall be able to selectively turn on or off the display of the vehicle status information on the geographical map display.  | H        |
| R3.2.2.1.3.18 | When multiple vehicles are located too close together to be displayed without overlapping at the selected zoom level, the System shall provide a means for the system user to see the individual vehicle identities for the overlapped vehicles.   | H        |
| R3.2.2.1.3.19 | System users shall be able to select individual vehicles from the list, display the associated vehicle information, and initiate a data transmission to the selected vehicle.  | H        |



### 3.2.2.1.4 Geographical Map Navigation

| ID           | Requirement  | Priority |
|--------------|--|----------|
| R3.2.2.1.4.1 | <p>The following navigation functions and features shall be provided to support System users when they are working with geographical maps:</p> <ul style="list-style-type: none"> <li>a. Rapidly select a specific map area for viewing by using a graphical map overview</li> <li>b. Locate selected vehicle IDs, run/block numbers, paratransit route numbers, and vehicle operator IDs on the map and center the selection on the display</li> <li>c. Locate a selected landmark on the map and center it on the display</li> <li>d. Center the display on any selected point of the currently visible map</li> <li>e. Center the display on a vehicle and continuously track the vehicle on the map</li> <li>f. Calculate the distance between two selected points on the map and accumulate the distance along the path formed by a series of selected points</li> <li>g. Coarse and fine panning of the display to bring any portion of the map into view</li> </ul> | L        |

### 3.2.2.1.5 Geographical Map Scaling

| ID            | Requirement   | Priority |
|---------------|---|----------|
| R3.2.2.1.5.1  | System users shall be able to zoom in and out on the map display to view specific areas of the territory at different levels of detail.   | H        |
| R3.2.2.1.5.2  | The range of display capability shall extend from displaying the entire map area at an overview level of detail to displaying a small portion of the map area in fine detail.                       | H        |
| R3.2.2.1.5.3  | Information shall be automatically added or deleted at selected scale (zoom) factors as the view is zoomed in or out, respectively.   | H        |
| R3.2.2.1.5.4  | At least eight (8) distinct zoom levels shall be supported.   | M        |
| R3.2.2.1.5.5  | System users shall be able to zoom in to a map level that allows at least six (6) vehicles lined-up within a 250-foot distance to be clearly distinguished, without overlap of the vehicle symbols. | M        |
| R3.2.2.1.5.6  | The map textual information such as street names, vehicle identities, route names, and landmark names displayed at the various zoom levels shall be clearly readable.                               | M        |
| R3.2.2.1.5.7  | Route and street names shall be repeated along lengthy routes and streets.  | M        |
| R3.2.2.1.5.8  | System users shall be provided with a map function that allows them to zoom in on a selected area of the geographical map by drawing and sizing a rectangle enclosing the area to be expanded.      | L        |
| R3.2.2.1.5.9  | The area enclosed by the drawn rectangle shall be expanded to the full display area available for the geographical map display.   | L        |
| R3.2.2.1.5.10 | The System Administrator shall be able to specify the default attribute information that will appear at each zoom level.  | L        |
| R3.2.2.1.5.11 | The Contractor shall provide an initial configuration that satisfies the specified viewing requirements.  | M        |

### 3.2.2.1.6 Vehicle Overlay Filtering

The Owner plans to group vehicles into fleets comprised of a fixed route revenue fleet, a paratransit fleet, a snow plow fleet, a maintenance vehicle fleet, and a supervisory vehicle fleet. Additional fleets will be added in the future to accommodate other vehicles and operational users requiring AVL capabilities.

| ID           | Requirement  | Priority |
|--------------|--|----------|
| R3.2.2.1.6.1 | System users shall be able to restrict the display of AVL-equipped vehicles on the geographical map to any combination of the following criteria:<br><ul style="list-style-type: none"> <li>a. All vehicles of one or more fleet(s)</li> <li>b. All revenue vehicles on all routes</li> <li>c. Revenue vehicles on selected routes</li> <li>d. All non-revenue vehicles</li> <li>e. All supervisory vehicles</li> <li>f. All maintenance vehicles</li> <li>g. All vehicles</li> <li>h. A single vehicle</li> <li>i. Combinations of the above</li> </ul> | H        |
| R3.2.2.1.6.2 | The mechanism for defining the routes (and the associated vehicles) that are displayed shall be convenient and shall not be solely dependent on the manual entry or individual selection of the specific route numbers to be displayed.  | M        |
| R3.2.2.1.6.3 | Other mechanisms, such as allowing system users to conveniently select one or more pre-defined groups of routes for display shall be supported.  | M        |
| R3.2.2.1.6.4 | System users shall be able to display any vehicles and/or routes that exist in the system.   | M        |
| R3.2.2.1.6.5 | System users shall be limited to displaying only those fleets, vehicles, and routes which have been assigned to the user for their work assignment.  | M        |
| R3.2.2.1.6.6 | System users shall be able to concurrently display the vehicles for up to forty (40) routes on the geographical map display.   | M        |

### 3.2.2.2 Event Queue Display

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.2.2.2.1 | A tabular display shall be provided that displays the event queue.  | M        |
| R3.2.2.2.2 | Events shall be partitioned so that each user sees only those events that pertain to his/her area(s) of responsibility.   | M        |
| R3.2.2.2.3 | If events are listed in a single queue, the system administrator shall be able to define the order that the event queue fields are displayed as well as the priority assigned to each event type and the color to be used for each event priority level.        | L        |
| R3.2.2.2.4 | If events are separated into queues according to the type of event (e.g.: communications, service, etc.), the system administrator shall be able to define the priority assigned to each event within each queue and the color to be used for each event queue. | L        |
| R3.2.2.2.5 | Events shall be ordered by decreasing priority, and ordered chronologically (oldest first) within each priority as the default mode of presentation.  | L        |

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.2.2.2.6  | The System shall enable users to reorder the events in a queue by sorting on any displayed field.  | L        |
| R3.2.2.2.7  | The System shall provide a means to quickly return the display to the default ordering.  | L        |
| R3.2.2.2.8  | Scrolling shall be supported when there are more events in a queue than can be displayed at once.  | L        |
| R3.2.2.2.9  | Each system user shall be able to concurrently display at least twenty (20) events in the event queue(s).  | L        |
| R3.2.2.2.10 | Events that are unanswered (i.e., those which a system user has not yet responded) shall be clearly distinguishable from all other events.   | L        |
| R3.2.2.2.11 | The fields (table columns) to be presented for each event shall include the type of event, time of occurrence, route number, run/block number, vehicle ID, vehicle operator name and employee ID, a text description of the event, event status (e.g., unanswered, selected by another system user, completed, etc.) and any important event attributes (e.g., schedule deviation amount). | L        |
| R3.2.2.2.12 | The system administrator shall be able to define the default order in which the event queue fields are displayed.  | L        |
| R3.2.2.2.13 | The time of occurrence shall be displayed in a 24-hour format showing hours, minutes, and seconds.   | L        |
| R3.2.2.2.14 | Clearly descriptive text and/or abbreviations shall be used for uniquely identifying each event type.  | L        |
| R3.2.2.2.15 | The full set of attributes for an event shall be viewable by selecting the event.  | L        |
| R3.2.2.2.16 | The text description shall uniquely describe each type of event such as emergency alarm, request to talk, schedule and route deviations, and the specific text associated with predefined data messages and MDT function key operations received from vehicles.  | L        |
| R3.2.2.2.17 | In the case of lengthy data messages, at least the first twenty (20) characters of each data message shall be displayed in the event queue.  | L        |
| R3.2.2.2.18 | For messages longer than twenty (20) characters, the full text of the message shall be displayed to the user when the particular event is selected.  | L        |
| R3.2.2.2.19 | Numeric and cryptic alphabetic codes shall not be used for the event descriptions.   | L        |
| R3.2.2.2.20 | An audible tone shall sound if a user's event queue contains no unanswered events and a new event is being added to the user's event queue.  | L        |
| R3.2.2.2.21 | The event queue audible tone shall consist of a single short beep.   | L        |
| R3.2.2.2.22 | The event queue display shall provide for the convenient selection of events in the queue and for initiating follow-up actions pertaining to the selected event.   | L        |
| R3.2.2.2.23 | Follow-up actions shall include generating and updating incident reports, transmitting a data message to one or more vehicles, returning the event to the event queue, and logging events.   | L        |

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.2.2.2.24 | Once an event is selected, all information pertaining to that event and other pertinent data including the vehicle ID, vehicle operator name, schedule and route adherence status, complete text of the message, incident report number (if present), and fields for initiating follow-up actions shall be displayed in an area or window separate from the event queue. | L        |
| R3.2.2.2.25 | The System shall provide the ability to select multiple contiguous and non-contiguous events in the display to support rapid event removal.  | L        |
| R3.2.2.2.26 | After selecting an event, but before initiating communications, system users shall be able to return the event to the event queue.   | L        |

### 3.2.2.3 Service Performance Display

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.2.2.3.1 | A tabular display, or integrated set of displays, shall be provided that enables System users to quickly monitor the current service performance and operations throughout the fleet.  | M        |
| R3.2.2.3.2 | The service performance display(s) shall indicate the schedule and route adherence of fixed route and paratransit vehicles and operational events such as late pull-outs, late logons, vehicle movements without logging-on, and late pull-ins.  | M        |
| R3.2.2.3.3 | Basic identifying information, such as vehicle ID, employee ID, route number, run/block number, time, and the type and magnitude of the service performance or operational event shall be presented for each event.  | M        |
| R3.2.2.3.4 | The service performance and operational events to be presented shall include, but not be limited to, the following: <ul style="list-style-type: none"> <li>a. Off-schedule status – indicate each scheduled fixed route vehicle that is off schedule, the schedule deviation, and the next scheduled time point</li> <li>b. Off-route status – indicate each fixed route vehicle that is off route, the distance off route, and the next scheduled time point</li> <li>c. Late logons – indicate each run/block that is not logged in on time and the scheduled logon time</li> <li>d. Late pull-outs – indicate each assignment/ block that is late in pulling-out, the scheduled pull-out time, and the associated vehicle status, if logged in</li> <li>e. Late pull-ins – indicate each run/block that is late pulling in, the scheduled pull-in time, and the associated vehicle status, if logged in</li> <li>f. Movement without logon – indicate any revenue or non-revenue vehicle that moves beyond the established limits without logging on</li> </ul> | M        |
| R3.2.2.3.5 | Status information shall be organized such that the most critical service issues are displayed first followed by less critical service issues, and finally, if included in the display, all service that is within normal operating thresholds.  | M        |
| R3.2.2.3.6 | Service performance and operational events of the same type that are based on a deviation from a value or reference point (e.g.: schedule deviation, late pull-outs, etc.) shall be listed in descending order of the magnitude of the deviation.  | M        |

### 3.2.2.4 Actual Versus Scheduled Headway

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.2.2.4.1 | A headway display shall be provided that graphically and numerically compares the scheduled headways between buses on each route with the actual headways.           | M        |
| R3.2.2.4.2 | System users shall be able to specify the route whose headways are to be displayed.  | M        |
| R3.2.2.4.3 | All buses operating on the route shall be displayed, separated according to the direction of travel along the route.   | M        |
| R3.2.2.4.4 | In cases where the actual route topology includes a split or similar diversion, these features can be “compressed” into a simplified linear presentation format.     | M        |
| R3.2.2.4.5 | The display shall show the time-points along the route, the scheduled locations of the vehicles, and the actual locations of the vehicles.                           | M        |
| R3.2.2.4.6 | The scheduled and actual vehicle locations shall be displayed in proper relation to the time-points.   | M        |
| R3.2.2.4.7 | The on-time performance of each bus shall be displayed.  | M        |
| R3.2.2.4.8 | Display selection buttons shall be provided on this display to allow system users to directly request the headway displays in each direction for the selected route. | M        |

### 3.2.2.5 Pull-Out Display

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.2.2.5.1 | A pull-out display shall be provided that lists pull-out information for revenue service.   | M        |
| R3.2.2.5.2 | The revenue service in the pull-out display shall be listed chronologically by service type, and shall be identified according to route and run/block numbers.  | M        |
| R3.2.2.5.3 | The scheduled pull-out time and actual pull-out time shall be displayed for each run/block number.  | M        |
| R3.2.2.5.4 | The pull-out display shall include the run/block numbers, the vehicle ID, and vehicle operator ID for each assignment.  | M        |
| R3.2.2.5.5 | Runs that are late in pulling out shall be highlighted on the display along with the number of minutes late.  | M        |
| R3.2.2.5.6 | The actual pull-out time shall be determined automatically by the System by tracking the revenue vehicle location and determining when the revenue vehicle actually leaves the base.  | M        |
| R3.2.2.5.7 | As a default, the runs listed on the pull-out display shall be all those revenue vehicles that are late in pulling out, have pulled-out within the past 30 minutes, and scheduled to pull-out within the next 60 minutes of the current time. | M        |
| R3.2.2.5.8 | System users shall be able to adjust time periods for pull-out categories as needed.  | M        |
| R3.2.2.5.9 | System users shall be able to delete entries from the pull-out display.   | M        |

### 3.2.2.6 Pull-In Display

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.2.2.6.1 | A pull-in display shall be provided that lists scheduled pull-in information for revenue service.  | M        |
| R3.2.2.6.2 | The revenue service in the pull-in display shall be listed chronologically by service type, and shall be identified according to route and run/block numbers.  | M        |
| R3.2.2.6.3 | The pull-in display shall list the time where each run of service is scheduled to be completed, the route and run/block number, vehicle ID, and vehicle operator ID.   | M        |
| R3.2.2.6.4 | As default, the revenue vehicles listed on the pull-in display shall be all those late in pulling-in, those that have pulled-in within the past 30 minutes, and those scheduled to pull-in within the next 60 minutes of the current time. | M        |
| R3.2.2.6.5 | System users shall be able to adjust time periods for the pull-in display categories as needed.  | M        |
| R3.2.2.6.6 | System users shall be able to delete entries from the pull-in display.   | M        |

### 3.2.2.7 Logged Event Display

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.2.2.7.1 | A display shall be provided that allows system users to selectively view events that have been logged during the current service day.  | M        |
| R3.2.2.7.2 | Logged events shall be listed in a date and time-sequenced order according to the time and date that the event was created.  | M        |
| R3.2.2.7.3 | The oldest selected logged events shall be at the top of the display.  | L        |
| R3.2.2.7.4 | Events created at the same time and date shall be listed in event priority order.  | L        |
| R3.2.2.7.5 | System users shall be able to selectively retrieve and display logged events based on a date, range of times, vehicle operator ID, vehicle ID, route number, run/block number, event type, system user, console position, or a combination of the above selection criteria.  | L        |
| R3.2.2.7.6 | The data to be displayed for each logged event shall include, but not be limited to, date and time that the event was created, the time that the event was logged, event type, route number, run/block number, vehicle ID, vehicle operator ID, and the system users that initially selected and logged the event. | M        |

### 3.2.2.8 Incident Report Displays

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.2.2.8.1 | A set of displays shall be provided for creating, editing, listing, saving, and tracking incident reports on events for which documentation is required.                                | M        |
| R3.2.2.8.2 | Summary displays separately listing all open and closed incident reports shall be provided, as well as incident report displays providing detailed information on individual incidents. | M        |

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.2.2.8.3  | When an incident is initially created, the System shall automatically fill-in all known information, such as the date, time, vehicle ID, route, direction, vehicle operator ID and name, run/block number, dispatch center personnel data, vehicle location, schedule and route adherence, and incident number.  | M        |
| R3.2.2.8.4  | Tab stops shall be provided for each data-enterable field to assist system users in entering the remaining data.   | M        |
| R3.2.2.8.5  | Validity checks shall be made on fixed-format fields to help ensure that entered data is in the proper format.   | M        |
| R3.2.2.8.6  | Validity checks shall be performed on fields where only certain entries are valid.   | M        |
| R3.2.2.8.7  | Authorized system users shall be able to call up and select from lists of valid entries for each field that has a defined set of valid entries.  | M        |
| R3.2.2.8.8  | Incidents shall be created based on system user command and automatically in certain cases such as a late pull-out.  | M        |
| R3.2.2.8.9  | The system administrator shall be able to define the events that shall cause an incident report to be generated automatically.   | M        |
| R3.2.2.8.10 | Authorized system users shall be able to retrieve an incident report by entry of the incident number, by selection from the incident report menu, and by accessing it through the associated event message in the event queue.   | M        |
| R3.2.2.8.11 | A user's ability to edit an incident shall depend upon factors such as whether the incident is still open or whether the user has full access as defined by assigned data partition(s).  | M        |
| R3.2.2.8.12 | System users shall be able to request a full menu listing of all open and closed incident reports for the current day, as well as lists of incident reports that meet defined selection criteria.  | M        |
| R3.2.2.8.13 | Incident report selection criteria shall include the following categories: <ul style="list-style-type: none"> <li>a. All incidents within a defined time period (default to current day)</li> <li>b. All incidents for defined service types (fixed-route, paratransit, etc.)</li> <li>c. All incidents for defined routes</li> <li>d. All incidents for defined vehicle IDs</li> <li>e. All open incidents</li> <li>f. All closed incidents</li> <li>g. All incidents of a particular type</li> <li>h. All incidents opened and closed by particular dispatch center personnel</li> <li>i. All revenue vehicle-related incidents</li> <li>j. All vehicle related incidents</li> <li>k. All incidents for a particular vehicle operator or employee number</li> <li>l. Logical combinations of the above criteria</li> </ul> | L        |
| R3.2.2.8.14 | Users shall not be able to set selection criteria that enable them to see incidents outside of their assigned data partition(s).   | M        |
| R3.2.2.8.15 | Dispatch center personnel and other personnel authorized to create incidents shall not be required to close all their open incident reports prior to logging-off of the System nor shall open incident reports be automatically closed upon log-off.   | M        |
| R3.2.2.8.16 | Open incident reports shall remain open and available to other system users to update, complete, or close.   | M        |
| R3.2.2.8.17 | When an incident report is closed, the System shall automatically fill-in data indicating the user responsible for closing the incident report.  | M        |

| ID          | Requirement   | Priority |
|-------------|---|----------|
| R3.2.2.8.18 | Once an incident report is closed, only authorized personnel shall be permitted to edit the closed incident report. | M        |

### 3.2.2.9 Vehicle Operator Information Display

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.2.2.9.1 | The System shall provide a means for creating, viewing, editing, and deleting information about the vehicle operators. | M        |

### 3.2.2.10 Vehicle Information Display

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.2.2.10.1 | The System shall provide a means for system users to view information and assignments pertaining to selected vehicles, without locating and selecting the vehicle on the geographical map display.   | H        |
| R3.2.2.10.2 | System users shall be able to specify the revenue and non-revenue vehicles for which information is to be displayed based on run/block number, paratransit route number, or vehicle ID.  | H        |
| R3.2.2.10.3 | The data to be displayed for each vehicle shall include, but not be limited to, route number, run/block number, vehicle ID, vehicle operator ID, vehicle operator name, schedule and route adherence status (if applicable) and the log-in status. | H        |

### 3.2.2.11 Schedule and Assignment Information Display

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.2.2.11.1 | System users shall be able to view schedule information and work assignments pertaining to designated vehicles, vehicle operators, and run/block numbers.        | M        |
| R3.2.2.11.2 | System users shall be able to specify the vehicle ID, vehicle operator ID, or run/block number for which information is to be displayed.                         | M        |
| R3.2.2.11.3 | For each trip assigned to a designated run/block number, the System shall show the start time, end time, route and vehicle operator ID, and vehicle ID.          | L        |
| R3.2.2.11.4 | For each piece of work assigned to a designated vehicle operator ID, the System shall show the start time, end time, route and run/block number, and vehicle ID. | L        |
| R3.2.2.11.5 | For each piece of work assigned to a designated vehicle ID, the System shall show the start time, end time, route and run/block number, and vehicle operator ID. | L        |

## 3.2.3 External System Interfaces

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.2.3.1 | The Contractor shall be responsible for the design and implementation of all System interfaces to the specified external systems. | H        |



| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.2.3.2 | The System interfaces to external systems shall utilize, to the fullest extent feasible, the capabilities already present in the external systems, so as to minimize the need for modifications to those systems. | H        |
| R3.2.3.3 | Designs shall employ “open” data access techniques, such as Open Database Connectivity (ODBC), for direct access interfaces and use standard file formats for file-based data exchange interfaces.                | H        |
| R3.2.3.4 | System performance requirements shall be met even while data transfer activities are taking place between the System and external systems.  | H        |
| R3.2.3.5 | External interfaces shall be fully designed and documented by the Contractor to an extent sufficient for third parties to implement and/or modify the external side of the interface.                             | H        |

### 3.2.3.1 AVL to ATIS System Interface

The System shall support an interface to an external ATIS system to be developed for the Owner at a later date.

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.2.3.1.1 | The System shall export the schedule information for all fixed-route schedules in a TriMet schedule data format specified in Appendix C. | H        |
| R3.2.3.1.2 | The System shall export the current fixed-route fleet vehicle locations in the format specified in Appendix C.                           | H        |
| R3.2.3.1.3 | The System shall export the schedule and location data to an administrator designated location.  | H        |
| R3.2.3.1.4 | The System shall export the schedule information on request by the system administrator.   | H        |
| R3.2.3.1.5 | The System shall export the vehicle location data on an administrator selectable schedule of 1 to 10 minutes.                            | H        |
| R3.2.3.1.6 | The System shall provide the option for the administrator to halt and restart scheduled vehicle location data transfers.                 | H        |

### 3.2.3.2 AVL to External AVL System

The System will need to be equipped to exchange AVL data with external AVL data sources and other AVL data display systems.

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.2.3.2.1 | The system shall import data from a standard file containing location data for one or more vehicles in a fleet.   | H        |
| R3.2.3.2.2 | The system shall export data in a standard file format to an administrator designated file and location which shall contain the location data for all vehicles in a designated fleet. | H        |
| R3.2.3.2.3 | The format of the standard file for import and export of fleet location data shall be as described in Appendix C.   | H        |
| R3.2.3.2.4 | The system shall be capable of importing and exporting data for at least thirty (30) fleets with at least 100 vehicles per fleet.   | H        |

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.2.3.2.5 | The system shall be equipped to import and export fleet location data on an administrator configurable time interval from 1 to 10 minutes. | H        |
| R3.2.3.2.6 | The system shall archive and display imported fleet data in the same manner as fleet location data collected directly by the system.       | H        |

### 3.2.3.3 AVL to GIS Data Interface

It is expected that the base GIS map data will change infrequently but that route, time point, bus stop, and other overlay data will change on a periodic basis.

All Lancaster County GIS databases are in a common map projection referred to as “County Grid”. Table 3 provides the description of the County Grid projection.

**Table 3 - Lancaster County Grid Projection**

|                              |                  |
|------------------------------|------------------|
| <b>Projection</b>            | Transverse (UTM) |
| <b>Units</b>                 | U.S. Survey Feet |
| <b>Spheroid</b>              | GRS80            |
| <b>Datum</b>                 | NAD83            |
| <b>Parameters:</b>           |                  |
| <b>Scale Factor</b>          | 1.000054615      |
| <b>Central Meridian</b>      | -96 41 17        |
| <b>Projection Origin</b>     | 40 15 00         |
| <b>False Northing-meters</b> | 0.0              |
| <b>False Easting-meters</b>  | 50,000           |

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.2.3.3.1 | The Contractor shall provide the Owner with all of the software necessary for importing the base GIS map and other GIS data needed by the System from the Owner’s ESRI GIS system. | H        |

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.2.3.3.2 | The base map data, route segment data, map overlays, and time point/bus stop data contained in the Owner's GIS map shall be imported into the GIS database used by the System for schedule and route adherence, geographical map displays, and all other System applications and displays requiring GIS data. | H        |
| R3.2.3.3.3 | The System shall support importing updates from the Owner's GIS overlay data at least once a month.   | H        |

#### 3.2.3.4 General Data Exchange Interface

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.2.3.4.1 | The System shall support the exchange of data needed by the System that resides on the Owner network and any System data that needs to be transferred to the Owner's network.  | H        |
| R3.2.3.4.2 | The System shall support the future distribution and display of Owner information to a variety of Owner information devices and systems that may be implemented in the future, including bus stop and transit center displays, interactive kiosks, the Internet, other transit agencies, and regional information systems besides the Advanced Traveler Information System of Section 3.2.3.2. | H        |

#### 3.2.3.5 System Data Radio Communications Interface

The Owner will purchase 1xRTT or EVDO cellular data services with a local carrier for each vehicle. The service contract will not include the cellular data air cards, modems or radios.

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.2.3.5.1 | The Contractor shall provide all data radio equipment required to interface the System components to the cellular data service for data radio communications. | H        |
| R3.2.3.5.2 | The data radio communications interface shall support all functional requirements as defined in this Specification.   | H        |

#### 3.2.3.6 System Network Interface

A description of the Owner's existing LAN at the dispatch center can be found in Appendix B. The Owner's existing Oracle server cluster can be accessed through this network.

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.2.3.6.1 | The System shall be interfaced to the Owner's LAN for exchanging data with other Owner computer systems and networked workstations. | H        |
| R3.2.3.6.2 | The computer systems to be interfaced via the Owner's LAN are defined in Appendix B.  | H        |

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.2.3.6.3 | The interface to the LAN shall support the following access and data exchange: <ul style="list-style-type: none"> <li>a. Downloading of revised GIS maps to the System from an Owner file server</li> <li>b. Providing Owner users on the LAN with read-only access to the system owner information and playback database, while restricting their access to the System LAN</li> <li>c. Providing designated Owner workstation users on the Owner LAN with necessary access to System functions</li> <li>d. Exporting data files to the Owner's ATIS system(s)</li> <li>e. Exchanging AVL data with external AVL systems</li> <li>f. Supporting other data exchanges required to meet the functional requirements defined in these specifications</li> </ul> | H        |
| R3.2.3.6.4 | The Contractor shall provide all necessary hardware and software to interface to the Owner's LAN.  | H        |

### 3.3 Performance Requirements

The requirements in this section specify static and dynamic capacity for number of users, connections, and other performance related factors.

#### 3.3.1 System Capacity

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.3.1.1 | The system shall support the tracking of 100 vehicles initially, with expansion capacity to accommodate 1000 vehicles.   | H        |
| R3.3.1.2 | The system shall support five (5) fleet groupings initially, with expansion capacity to accommodate thirty (30) fleet groups.  | H        |
| R3.3.1.3 | The System shall initially support the functions specified herein with the quantities and types of devices, workstations, vehicles, and vehicle equipment listed in Appendix B.  | H        |
| R3.3.1.4 | Next stop, major intersection, and key transfer point announcement and display capacity shall be sufficient to support all of the routes in the Owner service area and all of the trips made by each vehicle during a service day, plus a 50% spare capacity for other types of announcements. | H        |

#### 3.3.2 System Scalability

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.3.2.1 | All software shall be easily expandable to accommodate the anticipated System, system user, and transit service growth as defined in this specification without reassembly, recompilation or replacement of the software.   | H        |
| R3.3.2.2 | The size and configuration of the system shall be specified by easily modified parameters contained in centralized system parameter files.  | H        |
| R3.3.2.3 | In addition to the workstation quantities listed in Appendix B, the System shall support the future addition of ten (10) workstations.  | H        |
| R3.3.2.4 | The System shall be easily scalable over its estimated 10-year lifetime to support the specified future expansion and future functionality, including the additional vehicles and vehicle equipment, functions, system users, workstations, and transit services without replacement of existing major components, including both hardware and software components. | H        |

### 3.3.3 System Performance

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.3.3.1 | Vehicles shall report their current location at least once every 60 seconds.                                    | H        |
| R3.3.3.2 | Vehicles that are off-route or off-schedule shall report their current location at least once every 15 seconds. | H        |

#### 3.3.3.1 Processor Utilization

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.3.3.1.1 | Workstations shall utilize no more than 40% of total processing capability while executing all System client application software that is required by the associated workstation position under peak loading conditions. | H        |
| R3.3.3.1.2 | Servers shall utilize no more than 40% of total processing capability while executing all System application software under peak loading conditions.   | H        |

#### 3.3.3.2 Display Response Time

For these requirements, display response time is defined as the response time to display current database data on a display. The Owner realizes that a complex geographical map display may require a longer initial response time than other system displays.

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.3.3.2.1 | When a new display is requested by the user, the new display, complete with data values, shall appear on the dispatch center workstation screens within 2 seconds and within 3 seconds at remote workstations, under peak load conditions. | H        |
| R3.3.3.2.2 | Due to the complex nature of geographical map displays, an additional 3 seconds shall be allowed for a new geographical map display call-up.   | H        |

#### 3.3.3.3 Display Update Rate

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.3.3.3.1 | Once a display containing dynamic data is active, the display shall be updated to ensure a data latency of no more than 2 seconds.                     | M        |
| R3.3.3.3.2 | Displays may be updated with new data on a periodic basis of at least every 2 seconds, or displays can be updated as changes to the data occur.        | M        |
| R3.3.3.3.3 | Data on displays that are being viewed by a user shall be updated regardless of whether or not the window containing the display is the active window. | M        |
| R3.3.3.3.4 | The maximum allowable data latency for remote workstations shall be 10 seconds.  | M        |
| R3.3.3.3.5 | From the start of visible update activity, an update shall be completed within 1 second at both local and remote workstations.                         | M        |

### 3.3.3.4 Map Display Response Times

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.3.3.4.1 | A System user request to display an active geographical map display at a different scale factor shall be completed, including all displayed data updated, within three 3 seconds. | M        |
| R3.3.3.4.2 | A System user request to pan an active geographical map display to a different portion of the map shall be completed, including all displayed data updated, within 3 seconds.     | M        |

### 3.3.3.5 MDT User Interface Performance

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.3.3.5.1 | All vehicle operator actions performed via the MDT that are processed entirely by the System on-board equipment shall be completed in 1 second.   | M        |
| R3.3.3.5.2 | When the MDT user enters a request on the MDT to send an event (data message), the System shall provide immediate feedback to the user that the request has been accepted and is being processed, and shall notify the user when the message has been sent. | M        |
| R3.3.3.5.3 | When a data message is received by the System on-board equipment, the MDT user shall be notified and the message shall be available for display on the MDT within 1 second after it is received.  | M        |

## 3.3.4 System Availability

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.3.4.1 | The system shall be available on a seven day per week, 24 hours per day basis with no more that 2 cumulative hours of downtime per month. | H        |

### 3.3.4.1 Performance Monitoring

The Owner will purchase server hardware and software based on Contractor furnished hardware and software requirements. The specifications for this hardware and software must meet the following requirements.

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.3.4.1.1 | System performance monitoring software shall be provided for each server processor.   | H        |
| R3.3.4.1.2 | Software shall be provided to continuously monitor hardware and software performance and to gather performance statistics in real-time with a minimum of interference with the normal System functions.                       | H        |
| R3.3.4.1.3 | The time period over which the statistics are gathered and saved shall be adjustable by the system administrator, and the accumulated statistics, after storage in a "save" file, shall be reset at the start of each period. | H        |
| R3.3.4.1.4 | The system performance monitoring function shall include processor resource usage monitoring and application program resource usage monitoring.   | H        |

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.3.4.1.5 | The System shall include online services that permit the system administrator to individually enable, disable, and reinitialize each performance monitoring function.               | H        |
| R3.3.4.1.6 | The supplied system performance monitoring software shall be suitable for evaluating the performance of the System against specified requirements during factory and field testing. | H        |

### 3.3.4.2 Diagnostics and Error Monitoring

Options such as pager and e-mail notification are considered desirable features.

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.3.4.2.1 | The System servers shall employ on-line error monitoring.   | H        |
| R3.3.4.2.2 | System devices shall be monitored for both recoverable and non-recoverable errors at all times, even if a backup device is available.   | H        |
| R3.3.4.2.3 | The System shall monitor all devices and types of errors normally monitored by the operating system software.   | H        |
| R3.3.4.2.4 | Error monitoring statistics shall not be lost upon failover or restart.   | H        |
| R3.3.4.2.5 | The System shall enable the system administrator to configure notification alarms for specific error events.  | H        |
| R3.3.4.2.6 | The alarm notification shall provide a message at the workstations to all currently logged in system administrators.  | H        |
| R3.3.4.2.7 | Alarm notification shall be provided for, but not limited to, the following events: <ul style="list-style-type: none"> <li>a. Server disk failures</li> <li>b. Server Uninterruptible Power Supply (UPS) alerts</li> <li>c. LAN/WAN failures and error conditions</li> <li>d. Server failover and restarts</li> </ul> | H        |

### 3.3.5 System GPS Accuracy

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.3.5.1 | The minimum positional accuracy for both the positions used on-board the vehicles and the positions used by the System shall be 5 meters (2 dRMS). | H        |
| R3.3.5.2 | Velocity measurements provided by the GPS equipment shall be accurate to 0.1 meters/second.  | H        |
| R3.3.5.3 | The GPS time signals shall be accurate to $\pm 1$ ms.  | H        |

## 3.4 Design Constraints

The requirements in this section specify constraints imposed by standards, regulations, or hardware limitations.

### 3.4.1 General Characteristics

The City of Lincoln provides hardware and administrative support to StarTran for all servers. The City uses HP Pentium processor based servers and would prefer to have HP equipment purchased for this system for ease of support. The City would consider purchasing the server equipment to the contractor's specifications if this would facilitate the preferred equipment. Servers are currently maintained by the City and are upgraded or replaced on a three year cycle.

Dispatchers currently have 1 to 2 year old HP desktop computers which have 2.4 GHz Pentium processors, Windows XP, and 40 to 80 GByte hard drives. The City would prefer to retain these computers and use them for this system.

The City currently uses the Windows operating system predominately, with some Novel servers providing login authentication. The City would prefer software running on Windows 2003 (or newer) for the servers and Windows XP for any laptops and desktop applications. There is no strong preference for the operating system on the MDTs.

The City currently operates a clustered Oracle database server. Several smaller SQL Server deployments exist that are specific to applications. The City would prefer to implement any database services on the existing Oracle server, but would consider a SQL Server implementation if the system does not require support from a local database administrator.

### 3.4.2 Operating System Software

Requirements referring to "supplied" equipment will apply to equipment and software furnished by the Contractor and equipment furnished by the Owner in accordance with Contractor supplied specifications.

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.4.2.1 | Microsoft Windows 2003 Server, or later, shall be used for all supplied servers.   | H        |
| R3.4.2.2 | Microsoft Windows XP, or later, shall be used for all workstations.  | H        |
| R3.4.2.3 | All supplied operating systems shall not be modified or patched by the Contractor in a manner that is not approved by the operating system supplier. | H        |

### 3.4.3 Database Software

If the Contractor elects to provide database software instead of using the Owner furnished Oracle cluster server, the specified requirements will apply. The Owner prefers that Oracle be used, but could support SQL Server 2000, if necessary.

Regardless of the database software used for the System, or who supplies the software, the database software must meet the requirements of Section 3.6.9 of these specifications.



### 3.4.4 Server Hardware

The Owner has a preferred vendor for servers. Most of the Owner's servers are HP servers, which the Owner's staff are trained and certified to maintain. The Owner would prefer to purchase the servers for this project using a parts list provided by the Contractor. The equipment would be installed by the Contractor regardless of procurement method.

The Contractor will be responsible for interfacing the server hardware and software components to provide a complete and functional system meeting all of the specifications of this document. This responsibility is not relieved in any way should the server hardware be purchased by the City. Regardless of the procurement method used to secure the servers for this contract, the server hardware must meet the requirements in Section 3.7.3 of these specifications.

### 3.4.5 Operator Workstations

The existing dispatcher workstations are described in Appendix B. It is the intent of the Owner to use these workstations for the system operator workstations.

### 3.4.6 Owner Local/Wide Area Network

The Owner's existing network is described in Appendix B.

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.4.6.1 | The System shall include TCP/IP network software that supports the data communications within the System and its connections to the existing Owner network.                         | H        |
| R3.4.6.2 | The System shall include software for network communications, security, and management of network services.   | H        |
| R3.4.6.3 | Networking software shall consist of standard off-the-shelf products, preferably included as part of the supplied operating system(s).  | H        |
| R3.4.6.4 | The network software shall support access by system users to printers and file servers on the Owner LAN.  | H        |
| R3.4.6.5 | Network software, in conjunction with appropriate security software, shall support controlled access to the system owner information and playback server by users on the Owner LAN. | H        |

### 3.4.7 Space Descriptions

Floor plans, site plans, and other descriptive information about the sites and spaces where the System will be installed can be found in Appendix B.

### 3.4.8 Operational Environmental Conditions

Descriptive information about site environmental conditioning, power, and other support conditions can be found in Appendix B.

### 3.5 General System Qualities

The requirements in this section address the general quality, usability, extensibility, flexibility, and maintainability of the System. The Owner will consider changes in the software requirements and characteristics if it can be shown that a proposed alternative approach using the Contractor's standard, field-proven software will meet the functional needs of the System in a reliable and cost-effective manner.

New software, or software modified to satisfy this specification, will be considered specially designed for this project. The Owner reserves the right to approve the design of such special software without relieving the Contractor of the responsibility to meet the functional, availability, capacity, and expandability requirements of this specification.

#### 3.5.1 General Characteristics

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.5.1.1 | The Contractor shall provide standard, field-proven software products wherever possible.  | M        |
| R3.5.1.2 | All operating system, database, utility, and network software shall be products that are commercially available, standard, unmodified, and off-the-shelf products produced by well-established and reputable suppliers. | H        |
| R3.5.1.3 | The most recent version of each product that is available at the time of factory acceptance shall be provided, subject to the Owner approval.   | M        |
| R3.5.1.4 | For all third-party software, the Contractor shall install all applicable patches or service packs until final acceptance of the System by the Owner.   | M        |
| R3.5.1.5 | Third-party support and training shall be available for all standard commercially available software.   | M        |
| R3.5.1.6 | The Contractor shall provide the software licenses required to support the functions, features, tools, and number of users specified herein and required by the Contractor's proposed system.                           | H        |
| R3.5.1.7 | The Contractor shall provide any renewable subscription services included in the system implementation through the end of the System warranty period.   | M        |

#### 3.5.2 Access Security

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.5.2.1 | Access to the System shall be strictly limited to designated and authorized system users.   | H        |
| R3.5.2.2 | Users without proper minimum authorization shall be denied access to all System functions and data, as well as all System resources such as servers, laptops, and workstations. | H        |

##### 3.5.2.1 User Authorization

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.5.2.1.1 | System user authorization shall require entry of a valid username and password combination that determines the user's level of access to System functions and data. | H        |

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.5.2.1.2 | Each system user shall have a unique username that is assigned by the system administrator.   | H        |
| R3.5.2.1.3 | A secure method shall be provided for the system administrator to change passwords and system user identifications, define how often passwords must be changed, and define limits on the number of failed logon attempts allowed before further logon attempts are blocked. | H        |
| R3.5.2.1.4 | System users shall be permitted to modify their passwords.  | H        |
| R3.5.2.1.5 | A function shall be provided for users to log off of the System.  | H        |

### 3.5.2.2 Functional Partitioning

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.5.2.2.1  | Access to System functions and capabilities shall be based upon each user's authorization level and not the physical workstation being used, though limitations in functional capabilities due to the configuration of the workstation may apply (e.g., no voice equipment). | M        |
| R3.5.2.2.2  | Each access level shall be configurable for "full", "view-only", or "no" access to each System function or capability whose accessibility is configurable.   | M        |
| R3.5.2.2.3  | Unless otherwise stated, all users shall have read-only access to the System data.   | M        |
| R3.5.2.2.4  | A minimum of 8 access levels shall be supported by the System.   | L        |
| R3.5.2.2.5  | System administrators shall have unrestricted access to System functions and shall have special privileges required to administer overall access security and to maintain the System.  | M        |
| R3.5.2.2.6  | A secure method shall be provided for the system administrator to change passwords, user identifications, and functional and data partitions.  | H        |
| R3.5.2.2.7  | Dispatch center supervisors and paratransit managers shall have all of the rights of dispatch center personnel plus access to certain restricted System functions as determined by the system administrator.   | M        |
| R3.5.2.2.8  | Dispatch center personnel shall have full access to specific System functions as determined by the system administrator.   | M        |
| R3.5.2.2.9  | Service supervisors shall have full access to specific System functions as determined by the system administrator.   | M        |
| R3.5.2.2.10 | Owner service users shall have read-only access to selected System data and read-only access to historical data via the Owner information and playback server resources.   | M        |
| R3.5.2.2.11 | General users shall have read-only access to System historical data via the Owner information and playback server, but shall have no access to System functions.   | M        |

### 3.5.2.3 Data Partitioning

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.5.2.3.1 | The system administrator shall be able to define data partitions that specify, via selection criteria or other means, a subset of all System data, including events that users are permitted to access.   | M        |
| R3.5.2.3.2 | For each defined data partition, the system administrator shall be able to specify the type of access, which shall include at least “read-only” and “full access”.  | M        |
| R3.5.2.3.3 | Data partitions shall be able to overlap in definition and each data partition shall be assignable to any number of system users.   | M        |
| R3.5.2.3.4 | A minimum of 8 distinct data partitions shall be supported.   | M        |
| R3.5.2.3.5 | Data partitioning shall be possible based on any logical combination of the following criteria: <ul style="list-style-type: none"> <li>a. Division – Data associated with a specific division or base (Note: this level of data partitioning capability will not be needed initially but may be needed in the future.)</li> <li>b. Service Type — Data associated with a specific service type, such as “fixed route”, “paratransit”, or “non-revenue”</li> <li>c. Route Numbers — Data associated with a list of specific route numbers and from designated ranges of route numbers</li> <li>d. Event Type/Sub-Type — Events of specific types and sub-types. For example, it shall be possible to route all maintenance type events, such as mechanical failures being reported by way of monitored status points, MDT function keys, and canned vehicle operator messages, to specific console(s)</li> <li>e. Vehicle ID — Data associated with specific vehicles based on the vehicle ID</li> </ul> | M        |

### 3.5.2.4 Security Records

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.5.2.4.1 | Each user logon and logoff shall be recorded in the historical event log.   | M        |
| R3.5.2.4.2 | The recorded data shall include the date and time that the logon or logoff was executed, the name of the workstation, and the identification of the user. | M        |

### 3.5.3 Date and Time Coordination

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.5.3.1 | The System shall keep all components of the System synchronized to standard Universal Time Coordinated (UTC) time.  | M        |
| R3.5.3.2 | System components that shall be synchronized in time include all servers and all vehicle MDTs.  | M        |
| R3.5.3.3 | The time error between the standard time reference and any component of the System, including vehicle MDTs, shall not exceed 10 seconds.  | M        |
| R3.5.3.4 | In the event of a failure to synchronize with the selected time reference, the System shall generate an alarm to the system administrator, discontinue use of the reference time, and begin using its own internal clock. | M        |

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.5.3.5 | The system administrator shall be able to adjust the System date and time from a single, central location that automatically resynchronizes date and time for all components of the System.   | M        |
| R3.5.3.6 | The administrator initiated time adjustment shall be immediately accepted by all System components and shall not corrupt data files, such as the historical logs, nor adversely affect the state of other currently running programs. | M        |

### 3.5.4 Standards

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.5.4.1 | The System shall be designed to enable future adopted standards and data exchanges with other ITS systems to be supported, once the specific standards and interface requirements are defined.  | M        |
| R3.5.4.2 | The software provided shall comply with industry standards produced by national or international standards organizations, such as the IEEE, SAE, ISO, and OSF.                                  | M        |
| R3.5.4.3 | The Owner requires on-board vehicle equipment designs that support the accepted industry standard Vehicle Area Network (VAN) interface designs and protocols of SAE J1708, J1587, and J1939.    | M        |
| R3.5.4.4 | The VAN shall be based on the latest versions of the SAE J1708 and J1587 standards.   | M        |
| R3.5.4.5 | All on-board vehicle equipment shall be certified under the latest version of the SAE J1455 testing and guidelines.   | M        |
| R3.5.4.6 | All cables shall have protective split convoluted tubing coverings and shall adhere to the guidelines and requirements of the SAE J1455 and SAE J2202 standards.                                | M        |
| R3.5.4.7 | Compliance with industry standards shall not release the Contractor of the responsibility to meet all functional, availability, capacity, and expandability requirements of this Specification. | M        |

### 3.5.5 Automated Vehicle Location System Accuracy

| ID       | Requirement   | Priority |
|----------|---|----------|
| 3.5.5.1  | The AVL System shall include a Differential Global Positioning System (DGPS)-based AVL function.  | H        |
| R3.5.5.2 | The AVL function shall provide tracking and reporting of the locations of AVL-equipped vehicles with a positional accuracy of 5 meters or less, regardless of whether the vehicles are moving, on-route, off-route, have no assigned route, or are logged in. | H        |
| R3.5.5.3 | The required positional accuracy shall not be adversely impacted by GPS errors resulting from ionospheric, multi-path, and other reception errors.  | M        |
| R3.5.5.4 | The Contractor shall implement any other supplemental vehicle tracking methods and devices such as dead reckoning that are required under the Contractor's design approach to meet the required tracking vehicle accuracy.                                    | M        |

### 3.5.6 Automated Passenger Counting Accuracy

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.5.6.1 | The automated passenger counting system shall have an accuracy of +/- 3% for passenger ons and passenger offs. | M        |

## 3.6 Reporting and Data Management

### 3.6.1 Reports

Report requirements are not intended to define the set of all reports and reporting features necessary to meet the full functional requirements of this Specification. Report requirements defined in the following sections identify specific report designs and features that are either desired or required, as indicated, to accomplish some of the System functional requirements.

The Owner intends to utilize the Contractor's standard reports, as proposed, to the greatest extent possible. In some cases, the Contractor will be required to provide standard reports, adapt existing reports, or develop new reports.

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.6.1.1 | The Contractor shall provide all reports defined as well as all reports required by the Contractor's design approach for meeting the functional requirements of this Specification. | H        |
| R3.6.1.2 | The Contractor shall provide all standard reports that are normally included with its base system product.  | H        |

### 3.6.2 Report Production

In general, the format of the Contractor's standard reports may be used, provided the required information is presented.

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.6.2.1 | The System shall support production of predefined reports, which may be requested immediately upon System user demand and on System user-defined schedules.   | H        |
| R3.6.2.2 | Report schedules shall support one-time production of reports at specific dates and times and periodic report production at System user-defined intervals ranging from at least one hour to one month.                                | H        |
| R3.6.2.3 | The reporting function shall permit the definition of predefined collections of reports that can be conveniently referenced as a group.   | L        |
| R3.6.2.4 | The destination of the report output shall be system user-selectable and shall be routed to the system user's display (for immediate requests) and any System user selected printer(s) on the System network and the Owner's LAN/WAN. | H        |
| R3.6.2.5 | Reports directed to System user displays shall appear the same as the corresponding report when printed.  | H        |
| R3.6.2.6 | Report production shall support storage of report output into files at a System user designated location on any accessible network file server.   | H        |
| R3.6.2.7 | Report output file formats shall include a generic text format, HTML format, and Acrobat PDF format.  | M        |

### 3.6.3 General Report Features

The ability to automatically generate and distribute reports electronically via email is considered a desirable feature.

| ID        | Requirement  | Priority |
|-----------|--|----------|
| R3.6.3.1  | Authorized System users shall be able to display and print any and all reports supported by the System.  | H        |
| R3.6.3.2  | The System shall permit output manipulations such as changing the paper size, utilizing different printers, and reorienting the printed pages from landscape to portrait mode.   | H        |
| R3.6.3.3  | All reports shall be viewable on-demand via displays, and shall be printable both on demand by authorized users and automatically at scheduled times and intervals.  | H        |
| R3.6.3.4  | All report content shall be restricted to the assigned data partition(s) of the requesting user.   | M        |
| R3.6.3.5  | All reports shall include headings and footers on each page that include at least the report title, page number, the date and time that the report was generated, and, where applicable, the time period covered by the report.  | H        |
| R3.6.3.6  | All supplied reports shall support user-specified parameters that constrain the report content to specific date/time periods, service types, or vehicle types, as appropriate to the purpose of the report.  | M        |
| R3.6.3.7  | Report parameters shall have appropriate pre-configured defaults that are used to generate the report if the user does not specify specific parameters.  | H        |
| R3.6.3.8  | All parameters, both user-specified and default, shall be printed with the report on a report cover page, or equivalent, which lists all parameter settings that were used to generate the report.   | L        |
| R3.6.3.9  | All reports that include threshold parameters and status conditions based on threshold parameters (e.g., a report of schedule deviations, where the threshold is the definition of how many minutes behind schedule is defined as a "late" status), shall utilize the threshold value that was in effect at the time the data was collected and not the current threshold value. | H        |
| R3.6.3.10 | All reports shall be generated from the data stored in the historical database unless data required by the report is resident only in the online database and has not yet been replicated to the historical database.  | H        |
| R3.6.3.11 | Information displayed in columns shall have headers.   | H        |
| R3.6.3.12 | If a printed column length exceeds one page, successive pages shall have the column headers repeated.  | H        |
| R3.6.3.13 | For displayed reports, columns and row headings shall remain locked and not scroll outside of the viewable window area.  | H        |
| R3.6.3.14 | For all reports listed in this specification, the Contractor shall be responsible for assuring that each report contains the correct information and Owner nomenclature regardless of the nomenclature used in any existing standard Contractor reports.   | H        |
| R3.6.3.15 | The Contractor is not responsible for changing the nomenclature used in existing Contractor standard reports that are not listed in this specification.  | H        |

### 3.6.4 Incident Reports

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.6.4.1 | The System shall automatically produce a daily listing of all incident reports that were open during the service day. | M        |

| ID        | Requirement   | Priority |
|-----------|---|----------|
| R3.6.4.2  | The daily incident listing shall contain copies of all the incident reports, complete with all the data entered, sorted by incident type and by time.   | M        |
| R3.6.4.3  | The reporting period for the incident report shall begin when the previous service day's incident report summary ended.   | M        |
| R3.6.4.4  | Once an incident report is generated for a service day, it shall automatically be archived via the information storage function and printed on the designated printers.   | M        |
| R3.6.4.5  | All open incident reports shall be included in the current report and carried over to the next service day's reporting period.  | M        |
| R3.6.4.6  | The incident report summary shall summarize the number of incident reports listed in the report.  | M        |
| R3.6.4.7  | The following totals shall be provided:<br>a. Number of open incident reports carried over from previous days, by type of incident<br>b. Number of new incident reports opened, by type of incident<br>c. Total number of incident reports, by type<br>d. Total number of incident reports, combined<br>e. Number of incident reports that remain open, by type of incident<br>f. Number of incident reports that remain open, combined | M        |
| R3.6.4.8  | Authorized users shall be able to request a printout of all or selected incident reports on demand.   | M        |
| R3.6.4.9  | On-demand requests shall not affect the automatic incident summary reporting processing.  | M        |
| R3.6.4.10 | On-demand requests shall not cause the automatic incident report summary time period to be reset and shall not archive the on-demand report data.   | M        |
| R3.6.4.11 | Authorized users shall be able to select and print incident reports within a specified time period, by type, by responsible dispatch center personnel, by status (open/closed), and by incident report numbers.   | M        |

### 3.6.5 Schedule and Route Adherence Reports

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.6.5.1 | The Contractor shall provide a comprehensive set of reports that summarize and organize the schedule and route adherence data gathered by the System for evaluation by the Owner. | M        |
| R3.6.5.2 | Both standard and ad hoc schedule and route adherence reports shall be available.   | M        |



| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.6.5.3 | <p>The schedule and route adherence reports shall distinguish between each service schedule type (Weekday, Weekend, and Special). At a minimum, the following requirements shall be met:</p> <ol style="list-style-type: none"> <li>Provide a Schedule Adherence Summary Report that summarizes schedule adherence statistics for a specified time period (e.g. day, week, month, and year)</li> <li>Daily reports shall provide statistics broken down on an hourly basis along with daily totals</li> <li>Weekly reports shall provide statistics broken down on a daily basis along with weekly totals</li> <li>Monthly reports shall provide statistics broken down on a daily basis along with weekly and monthly totals</li> <li>Provide an ad hoc reporting capability to allow the schedule and route adherence data to be analyzed according to user specified query and report parameters including, but not limited to: <ol style="list-style-type: none"> <li>Select all time points, all time points of a particular route or groups of routes, selected individual time points or ad hoc groups</li> <li>Select all, groups, or individual revenue service types</li> <li>Select direction of route travel</li> <li>Select early/late report thresholds</li> <li>Select an individual day or a group of days, start/end dates, day of the week</li> <li>Select the timeframe within a day</li> <li>Calculate and report the average minutes early/late per time point, total early/late event count per time point, and percentage early/late per time point</li> <li>Provide grand totals and percentages</li> </ol> </li> </ol> | M        |

### 3.6.6 FTA Reports

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.6.6.1 | The Contractor shall provide reports corresponding to the FTA reports included in Appendix C. | H        |

### 3.6.7 Automatic Passenger Counting Reports

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.6.7.1 | The Contractor shall provide a comprehensive set of reports that summarize and organize the APC data.  | M        |
| R3.6.7.2 | Both pre-defined and ad hoc APC reports shall be available.  | M        |
| R3.6.7.3 | The reports shall distinguish between each service schedule type (weekday, weekend, and special).  | M        |
| R3.6.7.4 | The standard set of APC reports shall include bus stop level reports with passenger counts properly correlated to bus stops, summary reports, reports on passenger counts that could not be correlated to bus stops, and reports that help the Owner monitor the proper operation of the APC sensors and system. | M        |
| R3.6.7.5 | Passenger counts indicated on the bus stop-level reports shall be based on the counts following the Contractor-provided post-processing performed to eliminate or reduce passenger counting errors.  | M        |

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.6.7.6 | The APC reports on passenger counts that could not be correlated to bus stops shall list each uncorrelated count and all pertinent data associated with the count.   | M        |
| R3.6.7.7 | The APC reports for monitoring the proper operation of the sensors and system shall be based on measures such as looking for data trends in the data that indicate possible problems with a particular vehicle and looking for variations between the boarding and alighting counts that may indicate possible APC problems. | M        |
| R3.6.7.8 | The Owner's personnel shall be able to manually correct or exclude possibly erroneous APC data and fix the correlation of any APC counts not properly correlated to a bus stop and then rerun a report with the corrected data.  | M        |

### 3.6.8 Report Generation and Editing Software

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.6.8.1 | The System shall include functionality to allow authorized system users to generate new report formats and edit existing report formats.  | L        |
| R3.6.8.2 | The Contractor shall use the same report generation software provided to the Owner under this contract to construct all Contractor-provided reports.  | L        |
| R3.6.8.3 | The report generator shall enable an authorized user at any workstation to construct ad-hoc queries and define reports for any System data via interactive procedures that do not require knowledge of SQL. | L        |
| R3.6.8.4 | The capability to format reports for both display monitors and printers shall be provided.  | L        |
| R3.6.8.5 | Executing the report generating function shall not interfere with the on-line functions of the System.  | L        |

### 3.6.9 Database

The Owner prefers that Oracle 9i be used as the System database, but the Owner could support SQL Server, if necessary. The Owner prefers that the system use the Owner's existing Oracle cluster server, Oracle software, and Oracle software licenses.

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.6.9.1 | The System shall support 23-hour and 25-hour days to accommodate changeover to and from Daylight Saving Time.   | H        |
| R3.6.9.2 | The System shall include the ability to retrieve data for each of the duplicated hours on a 25-hour day and accommodation of the missing or additional hour in daily summaries.         | H        |
| R3.6.9.3 | The System shall include an online (i.e., continually updated and accessible) database that maintains information identifying each vehicle, fleet association, and current location.    | H        |
| R3.6.9.4 | The System database shall support industry-standard SQL (ISO 9075 or later) for all forms of access, and shall be ODBC compliant to enable access by ODBC-compatible user applications. | H        |

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.6.9.5 | All portions of the database, as delivered with the initial System, shall be sized to accommodate the ultimate user, fleet, and service area requirements described in this Specification.  | H        |
| R3.6.9.6 | The System shall include an online (i.e., continually updated and accessible) database that maintains comprehensive current and limited historical information on the System operating state, including, but not limited to, data on communications status, system status, route and schedule information, incidents, events, data required for displays and reports, data retrieved from the revenue and non-revenue fleets, data entered by system users, and data retrieved from other computer systems. | H        |
| R3.6.9.7 | The online database shall support industry-standard SQL (ISO 9075 or later) for all forms of access, and shall be ODBC compliant to enable access by ODBC-compatible user applications.   | H        |
| R3.6.9.8 | All portions of the database, as delivered with the initial System, shall be sized to accommodate the ultimate user, fleet, and service area requirements described in this specification.  | H        |

### 3.6.9.1 Adjustable Parameters

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.6.9.1.1 | Parameters designated as user-adjustable shall be adjustable via system displays normally accessible by the users.   | H        |
| R3.6.9.1.2 | Parameters designated as system administrator adjustable shall be adjustable via system displays normally accessible only by the system administrator.   | H        |
| R3.6.9.1.3 | Parameters designated simply as “adjustable” shall be modified by users or system administrators, depending on the Contractor’s standard approach.   | H        |
| R3.6.9.1.4 | Adjustments made to parameters by the system administrator and other system users shall become effective without having to reassemble or recompile programs or regenerate all, or portions of, the database, or restart the system software. | H        |
| R3.6.9.1.5 | All configurable periodicities and time intervals defined in this specification shall be considered initial values and shall be adjustable by authorized Owner personnel.  | H        |
| R3.6.9.1.6 | Periodicities and time intervals stated as performance requirements shall be met by the System.  | H        |

### 3.6.9.2 Reasonability of Data

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.6.9.2.1 | In order to prevent invalid and unreasonable data from having a harmful effect on the System or the Owner operations, data shall be checked for reasonability.                                 | M        |
| R3.6.9.2.2 | All input data and parameters, whether collected automatically or entered by a System user, shall be checked for reasonability before allowing the data to be processed or used by the System. | M        |
| R3.6.9.2.3 | Unreasonable data shall be rejected.   | M        |
| R3.6.9.2.4 | When unreasonable input data or results are detected, the System shall generate diagnostic messages that clearly describe the problem  | M        |
| R3.6.9.2.5 | All programs and the System shall continue to operate in the presence of unreasonable data.  | M        |
| R3.6.9.2.6 | Calculations dependent on the unreasonable data shall be suspended or continue to use the last reasonable data.  | M        |

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.6.9.2.7 | The System shall ensure that data expected to be numeric-only and alpha-only is in the proper alpha/numeric format before allowing the data to be entered into, or used by, the System. | H        |

### 3.6.9.3 Data Integrity

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.6.9.3.1 | The System shall be designed to protect System data integrity in a multi-user and multi-processing environment.  | M        |
| R3.6.9.3.2 | Appropriate exclusion methods shall be employed to ensure that collected data is not corrupted from multiple concurrent accesses by different processes. | M        |
| R3.6.9.3.3 | User entered data shall be protected by appropriate exclusion methods that prevent more than one user from simultaneously editing the same data.         | M        |
| R3.6.9.3.4 | Users shall be notified and granted read-only access to data that is being updated by another user.  | H        |

### 3.6.9.4 Online and Information Database Maintenance

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.6.9.4.1 | The System shall include all administrative and maintenance tools and functionality associated with the online and information databases.  | H        |
| R3.6.9.4.2 | Online and information maintenance tools shall include, but not be limited to: <ul style="list-style-type: none"> <li>a. performance monitoring and tuning</li> <li>b. backup, restoration and recovery</li> <li>c. facilities for modifying, extending, and adding database structures</li> </ul> | H        |

### 3.6.10 Information Storage Function

| ID        | Requirement   | Priority |
|-----------|---|----------|
| R3.6.10.1 | The System shall provide an information storage function that collects and stores all operational data for the purpose of later retrieval and analysis. | H        |

| ID        | Requirement   | Priority |
|-----------|---|----------|
| R3.6.10.2 | The operational data to be collected and stored by the System for later retrieval shall include, but not be limited to: <ul style="list-style-type: none"> <li>a. records of all events stored</li> <li>b. all data transmitted from the vehicle fleet (including log-on data,</li> <li>c. data messages</li> <li>d. schedule and route adherence status data</li> <li>e. vehicle location data</li> <li>f. APC data</li> <li>g. data transmitted from other equipment on-board the vehicles</li> <li>h. all data collected from the vehicles via bulk data transfers</li> <li>i. all data and messages transmitted to the vehicles</li> <li>j. all user-entered data,</li> <li>k. all user logons and logoffs</li> <li>l. all reports generated by the System</li> </ul> | M        |
| R3.6.10.3 | The stored data shall be time/date stamped and shall contain sufficient information to enable the selective sorting and retrieval of the data based on user-specified selection criteria.   | H        |
| R3.6.10.4 | Schedule and route deviations and changes in a previously reported schedule/route deviation shall be collected and stored.  | H        |
| R3.6.10.5 | Schedule and route deviation data shall include a date/time stamp, vehicle ID, run/block number, trip number, direction, vehicle location data, vehicle operator ID, and the magnitude of the schedule or route deviation.  | H        |
| R3.6.10.6 | The most-recent historical data shall be immediately accessible online to any authorized System user.   | H        |
| R3.6.10.7 | The online (short-term) accessible data shall include all historical data from the present to at least the past 3 months.   | H        |
| R3.6.10.8 | Online data older than the short-term cutoff shall be automatically transferred to long-term archive storage at pre-defined intervals.  | H        |
| R3.6.10.9 | All historical data, whether online or archived, shall be readily accessible to authorized System users.  | H        |

### 3.6.11 Historical Data Functions

| ID        | Requirement  | Priority |
|-----------|--|----------|
| R3.6.11.1 | The System shall provide a dedicated Owner information and playback database for recording historical data and supporting the functions and data access requirements of the owner information and playback server.                                     | M        |
| R3.6.11.2 | The playback database shall replicate necessary data from the online database and shall include any other data that may be required in order to satisfy all requirements of the information retrieval function as specified in the following sections. | M        |
| R3.6.11.3 | Linkage to suitable archive storage facilities shall be provided for the playback database in order to satisfy requirements for information retrieval of data residing in long-term storage.   | M        |
| R3.6.11.4 | Access via industry-standard SQL (ISO 9075 or later) and via third-party ODBC compliant front-end application software shall be supported.   | H        |

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.6.11.5  | The System shall enable users to retrieve, process, and format data for display, reporting, and exporting for use in other systems.   | M        |
| R3.6.11.6  | Processing capabilities shall include the ability to summarize retrieved data, including counts, totals, maximums, minimums, and averages.  | M        |
| R3.6.11.7  | Facilities shall be provided to convert retrieved data to common export formats, including a comma-delimited ASCII flat file, for transfer and subsequent use in external office applications (e.g., a spreadsheet).  | M        |
| R3.6.11.8  | Formatted reports and results of user queries shall be displayed and printed at the user's option.  | M        |
| R3.6.11.9  | A wide variety of formatting options shall be supported for presentation of retrieved data, including support for various paper sizes and orientations, various fonts, data grouping and sorting, and support for graphical analyses such as charts and graphs. | M        |
| R3.6.11.10 | The System shall include functionality for defining, saving, and recalling queries that will be frequently performed.   | M        |

### 3.6.12 Map Database

The GIS base map will be provided by the Owner and will contain the base road network and map overlay layers containing appropriate metropolitan landmarks, Owner-specific landmarks (e.g.: bus stops, paratransit-specific landmarks and locations, Base, intermodal facilities, and transit centers), and the Owner bus routes. The Owner's GIS base map and overlays are maintained under the ESRI ArcInfo GIS package.

| ID        | Requirement   | Priority |
|-----------|---|----------|
| R3.6.12.1 | The System shall include a GIS based database of the entire Owner service area.   | H        |
| R3.6.12.2 | The GIS database shall support all of the functions and features required by this specification, such as layering to permit separation of complex mapping information based on its type and/or function.                | H        |
| R3.6.12.3 | The GIS database shall be used by all map-related functions within the System, such as AVL.   | H        |
| R3.6.12.4 | The programming Application Program Interfaces (APIs) for interfacing with the GIS database shall be provided along with all relevant programming documentation on their use.   | L        |
| R3.6.12.5 | The Contractor shall import all Owner-provided maps and overlay data into the System.   | H        |
| R3.6.12.6 | The Contractor shall be responsible for defining no later than the Preliminary Design Review (PDR) all other data that is specified for the geographical map display but is not available in Owner-provided data files. | M        |
| R3.6.12.7 | The map overlay layers found in the GIS map file set provided by the Owner shall be preserved in the System such that System users can continue to selectively display each layer of data.                              | M        |

### 3.6.13 Information Retrieval Function

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.6.13.1  | The System shall provide an information retrieval function that enables authorized System users to selectively retrieve historical information.   | M        |
| R3.6.13.2  | The information retrieval function shall be designed to ensure that users performing ad-hoc retrieval from the stored information will not adversely affect the performance of online functions of the System.  | M        |
| R3.6.13.3  | The information retrieval function shall provide access security that is configurable by the system administrator.  | M        |
| R3.6.13.4  | The security features shall enable restriction of data access to view-only and shall permit further access restrictions to the data at both the table and field levels.   | M        |
| R3.6.13.5  | Selection criteria shall include text string matches on selected or all portions of fixed-format or free-format entries, or combinations of these criteria.   | M        |
| R3.6.13.6  | Definition of selection criteria shall support the use of "wild card" and partial match entries.  | M        |
| R3.6.13.7  | The following specific selection criteria shall be supported for accessing historical information: <ul style="list-style-type: none"> <li>a. Run numbers</li> <li>b. Block numbers</li> <li>c. Route numbers</li> <li>d. User ID</li> <li>e. Employee ID</li> <li>f. Date/time interval</li> <li>g. Type of data, message, and event</li> <li>h. Service Type</li> <li>i. Vehicle ID</li> <li>j. Schedule and route adherence (exceptions)</li> </ul> | M        |
| R3.6.13.8  | It shall be possible to combine any number of the selection criteria (R3.6.13.7) with logical operands (and, or) such that all data meeting the combined criteria can be retrieved.   | M        |
| R3.6.13.9  | Additional selection and sorting criteria for data shall include date/time stamps and ranges, status values, text string matches on selected data fields, and combinations of these criteria.   | M        |
| R3.6.13.10 | All information shall be retrievable in a fully decoded format.   | M        |
| R3.6.13.11 | The user shall not be required to interpret coded messages in order to determine the meaning of the retrieved data.   | M        |

### 3.6.14 Data Importation Software

| ID        | Requirement   | Priority |
|-----------|---|----------|
| R3.6.14.1 | The System shall include the functionality for authorized users to periodically import updates to all of the data needed by the System. | L        |

| ID        | Requirement   | Priority |
|-----------|---|----------|
| R3.6.14.2 | Data importation software, utilities, and scripts shall include, but not be limited to that required for importing new: <ul style="list-style-type: none"> <li>a. schedules</li> <li>b. routes</li> <li>c. bus stops</li> <li>d. timing points</li> <li>e. employee data</li> </ul> | L        |

### 3.6.15 Database and Data Ownership and User Rights

| ID        | Requirement   | Priority |
|-----------|---|----------|
| R3.6.15.1 | The Contractor shall grant the Owner unrestricted ownership, access, use, and distribution rights to all System data contained in all System databases and shall provide the necessary functionality for the Owner to access, use, and distribute the System data.  | L        |
| R3.6.15.2 | Ownership rights shall include production and test instances of the databases.  | L        |
| R3.6.15.3 | The Owner shall have the rights to use the ownership, access, use and distribution rights and the System functionality for creating interfaces to the System, for exporting System data to other Owner and third-party systems, for generating reporting capabilities, and for any other purposes for which the Owner chooses to use the System data. | L        |
| R3.6.15.4 | The Contractor-provided database access facilities shall include an Owner accessible data dictionary that fully describes and documents the contents and organization of all System databases.  | L        |
| R3.6.15.5 | Use of the database capabilities and the access, use, and distribution of the data by authorized and qualified Owner personnel shall not require that additional support, documentation, or licensing be obtained from the Contractor.  | L        |

## 3.7 Hardware

This Section describes the hardware requirements for the System including the fixed-location equipment and on-board vehicle equipment but excluding the radio equipment.

Hardware requirements and characteristics are discussed within the context of the design approach presented in these Specifications.

### 3.7.1 General Requirements

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.7.1.1 | All hardware shall be manufactured, fabricated, assembled, finished, installed, and documented with workmanship of high production quality and shall conform to all applicable international, national, state, and local standards. | L        |
| R3.7.1.2 | All hardware components shall be new and suitable for the purposes specified.   | L        |
| R3.7.1.3 | All hardware shall be designed, built, and installed to operate properly and reliably under the operating and environmental conditions to which the equipment will be subjected.  | L        |



| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.7.1.4 | The Contractor shall notify the Owner of any possible environmental deficiencies that could affect the System equipment in sufficient time for the Owner to remedy the situation. | L        |
| R3.7.1.5 | Delivered hardware shall include all applicable engineering changes and field changes announced by the equipment manufacturer since it was produced.                              | L        |

### 3.7.2 Hardware Procurement

All hardware required for meeting the functional requirements of this specification, and all hardware specified in this specification, shall be provided by the Contractor unless the specification specifically states that others will provide the hardware.

The Contractor shall be responsible for interfacing with existing hardware components and for coordinating with the other hardware providers to ensure that the System connects to and operates properly when interfaced to and integrated with these other hardware components.

### 3.7.3 Servers

The servers for the System must meet the following requirements regardless of the procurement method.

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.7.3.1 | The Contractor shall provide and install rack-mounted servers for the System, including all necessary racks, mounting hardware, cabling, and other components necessary for a complete and fully operating installation of the servers. | H        |
| R3.7.3.2 | Each server shall be equipped with sufficient main memory to meet all performance requirements of this Specification, but shall be a minimum of 1 GByte.  | H        |
| R3.7.3.3 | The Contractor shall provide one or more shared keyboard/video/mouse stations for managing all supplied server equipment.   | H        |
| R3.7.3.4 | Shared server access equipment shall be quickly and conveniently switched among associated servers without unplugging or re-attachment of cables and without adversely affecting the operation of the servers.                          | M        |
| R3.7.3.5 | A server utilizing a shared access setup shall be capable of booting up without the shared access equipment being switched to that server.  | M        |
| R3.7.3.6 | All server consoles shall be rack mounted in a location that is easily accessible by the user from a seated or standing position and within close proximity to the front panels of the associated servers.                              | M        |
| R3.7.3.7 | All server consoles shall consist of a color flat-panel monitor with at least a 15-inch diagonal screen, a QWERTY keyboard, and a mouse.  | M        |
| R3.7.3.8 | The server consoles shall be packaged to utilize a minimum of rack space and shall be retractable so as not to interfere with the use of rack doors.  | M        |

### 3.7.4 Printers

Information on existing printers can be found in Appendix B.

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.7.4.1 | The System shall be configured to print to the Owner's existing networked printers. | H        |

### 3.7.5 Workstation Equipment

The Owner would prefer to continue using the existing dispatcher workstation equipment. This equipment consists of HP desktop workstations with Pentium IV processors operating at 400 MHz, with 512 MB of memory and 30 GB hard drives.

No printers are required to be provided as part of the System. The Owner will provide all printers required for printing System output.

### 3.7.6 Local Area Network Equipment

The Owner's LAN is a 10/100BaseT Ethernet network running TCP/IP protocols. The network backbone is a fiber-based Gigabit Ethernet network. Diagrams of the Owner's existing network are provided in Appendix B.

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.7.6.1 | All network equipment furnished for this specification shall work with the Owner's existing Ethernet LAN and WAN.                  | H        |
| R3.7.6.2 | The supplied LAN equipment shall be Ethernet conforming to the IEEE 802.3 or IEEE 802.11g series standards.                        | H        |
| R3.7.6.3 | No more than 15% of the available access and transfer capacity of the supplied LAN shall be utilized under peak loading conditions | M        |
| R3.7.6.4 | The supplied System LAN speed shall be at least 100 Mbps for IEEE 802.3 network elements.  | M        |

### 3.7.7 Differential GPS Reference Receiver

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.7.7.1 | A DGPS reference receiver and antenna shall be provided and installed for supplying differential GPS corrections to each GPS-equipped vehicle.   | M        |
| R3.7.7.2 | The DGPS reference receiver and antenna shall be securely installed by the Contractor on the roof of the Owner's dispatch center.  | M        |
| R3.7.7.3 | The Contractor shall provide all equipment and cabling necessary for interfacing the DGPS reference receiver to the System, to the differential reference receiver antenna, and to the Owner furnished UPS power source. | M        |
| R3.7.7.4 | DGPS failures and/or loss of signal shall be alarmed to System users.  | M        |

| ID        | Requirement  | Priority |
|-----------|--|----------|
| R3.7.7.5  | The Contractor shall investigate, select, and propose the best location on the roof for installing the DGPS reference receiver and antenna for the Owner's approval.   | M        |
| R3.7.7.6  | The Contractor shall conduct, or use the GPS reference receiver to conduct, a precision survey to accurately and precisely determine the position of the installed GPS reference receiver antenna.   | M        |
| R3.7.7.7  | The Contractor shall be responsible for providing or leasing any test equipment required to perform the precision survey.  | M        |
| R3.7.7.8  | The Contractor shall be responsible for installing any necessary antenna mountings or supports and for properly weather-sealing all roof penetrations resulting from the installation of the DGPS reference receiver antenna.                  | M        |
| R3.7.7.9  | The differential corrections for each GPS satellite in view of the DGPS reference receiver shall be calculated by the DGPS reference receiver and transmitted to each GPS-equipped vehicle at a system administrator adjustable time interval. | M        |
| R3.7.7.10 | Differential correction transmissions initially shall be made at the Contractor's recommended rate provided differential corrections are transmitted at least every 30 seconds.  | M        |

### 3.7.8 Vehicle Operator Training Hardware (Optional)

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.7.8.1 | The Contractor shall provide 1 set of training equipment for training revenue and non-revenue vehicle operators on the proper use and operation of the on-board vehicle equipment in a classroom environment at the Owner's base.  | L        |
| R3.7.8.2 | Each set of training equipment shall be mounted in a rigid enclosure that is suitable for placement on a desktop and for use by the personnel being trained.   | L        |
| R3.7.8.3 | The training equipment shall be fully operational and shall be identical to the equipment being provided and installed by the Contractor in Owner buses, paratransit vehicles, and non-revenue vehicles.   | L        |
| R3.7.8.4 | The Contractor shall provide all hardware and software required to interface to all the devices in each set of training equipment.   | L        |
| R3.7.8.5 | The training equipment shall enable vehicle operators to be trained in all operations, functions, and features of the System vehicle equipment, including but not limited to: <ul style="list-style-type: none"> <li>a. the sending, receiving, and responding to data messages</li> <li>b. login and logoff sequences</li> <li>c. use of and meaning of all information displayed via the MDT</li> <li>d. the meaning of all buttons, indicators, lights, and menus on the MDT</li> <li>e. meaning of and proper actions to be taken in response to all vehicle operator prompts and error messages displayed via the MDT</li> <li>f. display and control of messages in the MDT message queue</li> </ul> | L        |
| R3.7.8.6 | The training equipment and software shall support data message exchanges between the trainees and the System.  | L        |

| ID        | Requirement  | Priority |
|-----------|--|----------|
| R3.7.8.7  | Vehicle operators using this training equipment shall be able to respond to each message and prompt and to receive proper and realistic responses to their actions.                                    | L        |
| R3.7.8.8  | The training equipment shall support normal vehicle operator responses and common problem situations that may occur during revenue service.  | L        |
| R3.7.8.9  | The equipment sets shall be powered from an Owner-furnished 120 VAC, 60 Hz power supply.   | L        |
| R3.7.8.10 | The training equipment shall be delivered to the Owner no less than 30 days before the scheduled start of the vehicle operator training so that the Owner instructors can finalize the training plans. | L        |

### 3.7.9 On-Board Vehicle Equipment

The Owner considers the ability to readily interface to a wide variety of on-board vehicle equipment manufactured by various suppliers as a crucial element in the design of the System. The Owner revenue and non-revenue fleets have a mixture of vehicle types and configurations. The current fleet is defined in Appendix B. For these revenue and non-revenue vehicles, the Contractor shall provide and install the types and quantities of on-board vehicle equipment as defined in Appendix C.

The availability and location of space for System equipment installation will vary according to the types of vehicles in the Owner's fleet and the dimensions of the Contractor-provided equipment. The Owner requires on-board vehicle equipment designs that support the accepted industry standard VAN interface designs and protocols of SAE J1708, J1587, and J1939.

The existing vehicle batteries installed on the vehicles will be used power all System equipment. The voltage input to the on-board System equipment will normally vary between 9 VDC and 15 VDC, although larger voltage dips can be expected during engine startup.

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.7.9.1 | The on-board vehicle equipment provided by the Contractor shall be designed, built, and installed for the harsh operating environment in which this equipment is to operate.   | H        |
| R3.7.9.2 | All Contractor-provided on-board vehicle equipment shall operate properly and reliably under the environmental conditions encountered on-board the vehicles including, but not limited to, conditions pertaining to temperature, humidity, electrical environment, dust/dirt, power variations, shock, vibration, washing, salt spray, fungus, altitude, and EMI/RFI interference. | H        |
| R3.7.9.3 | All on-board vehicle equipment shall be certified under the latest version of the SAE J1455 testing and guidelines.  | M        |
| R3.7.9.4 | All equipment housings shall be waterproof and dust-proof.   | H        |
| R3.7.9.5 | System vehicle equipment shall not adversely impact or degrade any existing vehicle equipment.   | H        |
| R3.7.9.6 | The Contractor shall provide and install all mounting brackets, hardware, and other materials required to securely install all Contractor-provided on-board vehicle equipment.   | H        |

| ID        | Requirement  | Priority |
|-----------|--|----------|
| R3.7.9.7  | The on-board vehicle equipment provided by the Contractor shall be designed for operation under the following minimum conditions: <ul style="list-style-type: none"> <li>a. EMI/RFI FCC part 15 subpart J, Class B</li> <li>b. Operating voltages 9 to 15 VDC</li> <li>c. Operating temperature -20° C to +60° C</li> <li>d. Humidity 98%/38° C</li> <li>e. Shock per latest SAE J1455 standard</li> <li>f. Vibration per latest SAE J1455 standard</li> </ul> | H        |
| R3.7.9.8  | The Contractor shall provide adequate protection for the on-board vehicle equipment to handle low-voltage situations and similar power excursions and transients commonly encountered on vehicles.   | H        |
| R3.7.9.9  | The on-board vehicle equipment shall not require any re-initialization, re-logons, and/or experience loss of data resulting from a voltage drop (this shall include situations where the engine is being re-started yet the on-board vehicle equipment is still powered-on and the power-off delay timer has not expired).   | H        |
| R3.7.9.10 | If batteries internal to the Contractor's equipment are used to support information stored in the on-board equipment, these batteries shall provide a 3-year (minimum) life under normal operating conditions; the batteries shall be readily available and the containing device shall have a low battery indicator.  | H        |
| R3.7.9.11 | Removal of all primary power to the on-board equipment or to support electronics shall not cause any loss of stored information.   | H        |
| R3.7.9.12 | The Contractor shall be responsible for inspecting each type of Owner vehicle and for determining how and where the equipment can be mounted, subject to the Owner's approval.   | H        |
| R3.7.9.13 | The Contractor shall be responsible for determining the exact dimensions and placement of any existing in-vehicle equipment.   | H        |
| R3.7.9.14 | The Contractor shall be responsible for designing, providing, and installing any mounting brackets and other hardware needed to securely mount the System equipment within or outside of existing enclosures, without disrupting or interfering with the existing equipment.   | H        |
| R3.7.9.15 | The Contractor shall verify that the proposed System equipment will operate properly and reliably in the selected locations, considering heat loads, electromagnetic interference, and other environmental factors.  | H        |
| R3.7.9.16 | The installation details, equipment and connectors being installed, placement of all on-board vehicle equipment and wiring, and any modification or moving of existing equipment shall be subject to the Owner review and approval.  | H        |
| R3.7.9.17 | No System equipment, mounting hardware, or wiring shall be installed within the vehicle manufacturer defined "airbag deployment zone" of any installed airbags.  | H        |
| R3.7.9.18 | In addition to the equipment that the Contractor is explicitly required to furnish by this specification, the Contractor shall provide any additional parts or equipment that are required to install and/or operate the Contractor-provided equipment on the Owner vehicles.  | H        |
| R3.7.9.19 | All Contractor-installed on-board vehicle equipment shall be easily accessible, modular, and easily removable to facilitate equipment troubleshooting, maintenance, and repair.  | H        |
| R3.7.9.20 | Convenient means, not requiring physical access to the components on each vehicle, shall be provided to allow the Owner to define and modify any software, user-configurable messages, parameters, function key definitions, and similar items pertaining to the vehicle equipment that the Owner may occasionally need to modify.   | H        |

| ID        | Requirement   | Priority |
|-----------|---|----------|
| R3.7.9.21 | The Owner shall be provided with any hardware, software, documentation, and training required for making these modifications. | H        |
| R3.7.9.22 | The on-board equipment shall be programmable using a personal computer and/or via a wireless link.                            | H        |
| R3.7.9.23 | Programming and other routine maintenance shall not require removal or replacement of internal devices of any kind.           | H        |
| R3.7.9.24 | The on-board System vehicle equipment shall store the vehicle ID.   | H        |

### 3.7.9.1 Mobile Data Terminals

The Owner plans to install the MDT equipment using plans, components, and mounting hardware provided by the Contractor. MDT design features that increase safe operation are encouraged.

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.7.9.1.1 | The Contractor shall provide MDTs in all Owner-designated vehicles.  | H        |
| R3.7.9.1.2 | The MDTs shall be of rugged construction and securely mounted on rigid Contractor provided support brackets that are customized by the Contractor as needed for each type and variation of vehicle within the Owner's fleet.   | H        |
| R3.7.9.1.3 | The Owner and the Contractor shall decide the placement and mounting of each MDT jointly no later than the final design review.  | H        |
| R3.7.9.1.4 | Each MDT shall be mounted and positioned within safe and convenient reach of the vehicle operator's seated position and where the MDT display and numeric/function buttons can be easily read and used by the vehicle operators.   | H        |
| R3.7.9.1.5 | The MDT and its placement shall be designed for safety.  | H        |
| R3.7.9.1.6 | The mounted MDT shall not obscure the vehicle operator's view out the windows and operation of the MDT shall be designed to allow the vehicle operators to operate the MDT and vehicle safely.   | H        |
| R3.7.9.1.7 | MDT design features that increase safe operation are encouraged.   | H        |
| R3.7.9.1.8 | The MDTs shall include a graphical display with a minimum resolution of 240 x 128 pixels that can display a minimum of 400 alphanumeric characters on a single display image.  | H        |
| R3.7.9.1.9 | At a minimum, this graphical display shall display and support: <ul style="list-style-type: none"> <li>a. Passenger transfer request messages between buses</li> <li>b. Messages received from system users</li> <li>c. Error messages (built-in test, vehicle equipment faults, etc.)</li> <li>d. Prompts and selection lists</li> <li>e. Status messages</li> <li>f. Time (in 24-hour format including seconds)</li> <li>g. Vehicle operator entries</li> <li>h. Status of messages sent via vehicle operator entries (entry sending, entry successfully sent)</li> <li>i. Soft-key button functions</li> <li>j. Other status and functions required to meet the functional requirements of the specification</li> </ul> | H        |

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.7.9.1.10 | MDT displays shall be designed to be easily readable by the vehicle operators in lighting conditions ranging from bright sunlight to darkness and by vehicle operators wearing sunglasses including polarized, un-polarized, “blue-block”, and other conventional types of sunglasses. | H        |
| R3.7.9.1.11 | The MDT displays shall be designed to minimize reflective glare from the front surface of the display.   | H        |
| R3.7.9.1.12 | Vehicle operator-accessible display controls for brightness and contrast shall be included.  | H        |
| R3.7.9.1.13 | Adjustment of display brightness and contrast over the useful range of settings shall be possible but adjustment of display brightness and contrast to settings where the display is unreadable shall be prevented.  | H        |
| R3.7.9.1.14 | The MDT display characters shall be at least ¼" in height.   | H        |
| R3.7.9.1.15 | Larger MDT display characters shall be utilized as necessary to meet accepted human factors design criteria for personnel with 20/20 vision at the distance and angle seated vehicle operators would be from the MDTs when the MDTs are mounted in the vehicles.                       | H        |
| R3.7.9.1.16 | MDTs shall provide backlit numeric/function button or “soft key” button functions for vehicle operator entry of numeric data, commands, and specific Owner-assignable control functions.   | H        |
| R3.7.9.1.17 | The functions assigned to each button shall be listed on the buttons, inscribed immediately above or below the button, or shown on the MDT display.  | H        |
| R3.7.9.1.18 | If the labeling describing the button’s function is placed on the button, it shall be in a manner that resists the labeling from being worn-off by repeated button pushes by the vehicle operators.  | H        |
| R3.7.9.1.19 | Entry of numeric data and selection of functions and entries shall be rapid and require a minimum of user actions, particularly for critical and frequently used functions.  | H        |
| R3.7.9.1.20 | MDT buttons shall be durable, wear-resistant, and large enough for convenient vehicle operator selection with a gloved hand.   | H        |
| R3.7.9.1.21 | The MDT buttons shall be spaced sufficiently far apart to minimize inadvertent selection of adjacent buttons.  | H        |
| R3.7.9.1.22 | The MDT buttons shall be logically grouped, color-coded, or arranged according to their assigned functions.  | H        |
| R3.7.9.1.23 | The MDTs shall produce audible tones when a voice call is received and when a new data message is displayed on the MDT that requires the vehicle operator’s attention.   | H        |
| R3.7.9.1.24 | The audible tones shall be capable of being heard over normal bus ambient noise levels.  | H        |
| R3.7.9.1.25 | The audio output level shall be adjustable by the vehicle operator within a restricted range that prevents audio output from being disabled.   | H        |

### 3.7.9.2 Vehicle Communication Gateway

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.7.9.2.1 | The Contractor shall provide a vehicle communication gateway for each vehicle equipped with a MDT.   | H        |
| R3.7.9.2.2 | Gateways shall be used for interfacing to the various initial and future on-board devices, interfacing to the VAN, for performing processing related to the on-board functions, and interfacing to and controlling the functionality of the data radios. | H        |

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.7.9.2.3 | The gateways provided by the Contractor shall initially support each of the initial on-board devices and functions required in this Specification.           | H        |
| R3.7.9.2.4 | The gateways shall have sufficient spare resources, card slots, and I/O ports to support the defined future devices and functional requirements.             | H        |
| R3.7.9.2.5 | The on-board time maintained by the gateway, and displayed on the MDT, shall be accurate to within 2 seconds of the correct time.                            | H        |
| R3.7.9.2.6 | The gateway may be packaged separately from, or combined with, the MDT.  | H        |
| R3.7.9.2.7 | Gateways provided by the Contractor shall have identical hardware configurations and shall be interchangeable between all vehicles in the Owner's fleet.     | H        |
| R3.7.9.2.8 | Any customization required to allow a gateway to be used for a particular vehicle or type of vehicle shall be performed in the software.                     | H        |
| R3.7.9.2.9 | The gateway, whether a stand-alone component or incorporated into the MDT, shall be the central controller for all data radio communications on the vehicle. | H        |

### 3.7.9.3 Power-Off Delay Timer

The Owner prefers designs that allow the power-off delay timer to be set to different times, according to the vehicle service type (fixed route, paratransit vehicle, or non-revenue vehicle).

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.7.9.3.1 | The vehicle communication gateways and MDTs shall remain powered on for an Owner adjustable period of up to 120 minutes after a vehicle engine is turned off to allow for layover periods at the end of a run and similar situations where data communications need to be maintained yet the vehicle engine is off. | H        |
| R3.7.9.3.2 | It shall not be necessary for the vehicle operators to logon again or take any other actions when the vehicle engine is restarted within the Owner set time period.   | H        |
| R3.7.9.3.3 | The vehicle communication gateway shall not power-off if on-going, off-peak processes are continuing, but shall have voltage sense circuitry in order to avoid depleting the vehicle battery below minimum starting voltage level.  | H        |
| R3.7.9.3.4 | The System equipment electrical load, when the vehicle engine is off, shall be minimized.   | H        |

### 3.7.9.4 Power Conditioning Equipment

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.7.9.4.1 | The Contractor shall supply, for all vehicle installations, appropriate equipment required to protect all System equipment from input power voltage drop and reversal during normal engine starts, emergency jump starts, and other transient conditions. | H        |
| R3.7.9.4.2 | The power conditioning equipment shall survive and protect down-line equipment from damage.   | H        |
| R3.7.9.4.3 | The power conditioning equipment shall filter transient line noise and spikes common from alternators, AC/DC motors (used for windshield wipers, wheelchair lift mechanisms, etc.), and interior lighting ballasts.                                       | H        |
| R3.7.9.4.4 | The power conditioner shall be installed between the vehicle's primary +12 VDC power bus and all new System equipment.  | H        |



### 3.7.9.5 Vehicle Wiring and Connectors

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.7.9.5.1 | Contractor shall provide all vehicle wiring and connectors required for the Contractor provided equipment and for interfacing to the existing vehicle equipment as required in this Specification. | H        |
| R3.7.9.5.2 | All cables shall have protective split convoluted tubing coverings and shall adhere to the guidelines and requirements of the SAE J1455 and SAE J2202 standards.                                   | H        |
| R3.7.9.5.3 | All connections shall be crimped securely.   | H        |
| R3.7.9.5.4 | The wiring and connectors shall be appropriate to the environment where the equipment is to be installed.  | H        |
| R3.7.9.5.5 | All vehicle-wiring designs shall be submitted to the Owner for approval prior to installation by the Owner.  | H        |

### 3.7.9.6 GPS Receivers and Antennas

| ID          | Requirement   | Priority |
|-------------|---|----------|
| R3.7.9.6.1  | The Contractor shall provide the on-board vehicle GPS receivers, antennas, and all necessary connections required to monitor the locations of all vehicles defined in Appendix C.   | H        |
| R3.7.9.6.2  | The GPS receivers shall be parallel (dedicated channel) tracking receivers, capable of simultaneously tracking at least twelve (12) GPS satellites in the best geometry for a position fix, and providing time signals to the Contractor-provided on-board vehicle equipment. | H        |
| R3.7.9.6.3  | The GPS receivers shall report latitude, longitude, velocity, time, direction of travel, and satellite tracking status.   | H        |
| R3.7.9.6.4  | The GPS receivers shall support all GPS satellites in orbit at the time the GPS equipment is delivered.   | H        |
| R3.7.9.6.5  | The GPS receivers shall have a warm start time to first fix (TTFF) solution time of 2 minutes or less and a signal reacquisition time of 15 seconds or less (following the loss of the signal for at least one minute).   | H        |
| R3.7.9.6.6  | The GPS equipment shall include multi-path rejection capabilities to help reduce the effects of spurious signals caused by reflections off buildings or other structures.   | H        |
| R3.7.9.6.7  | The System shall only be required to perform cold starts of the GPS receiver when the GPS is initially installed in a vehicle and possibly at times when a vehicle has been out-of-service for an extended time.  | H        |
| R3.7.9.6.8  | The GPS receiver shall have a coast-mode function to allow for a temporary loss of GPS fix without requiring recalibration after regaining GPS signals.   | H        |
| R3.7.9.6.9  | The on-board GPS receivers shall provide time signals to the other Contractor-provided onboard vehicle equipment.   | H        |
| R3.7.9.6.10 | The GPS receiver shall store the GPS almanac in non-volatile RAM.   | H        |
| R3.7.9.6.11 | The GPS antennas shall support the number of channels tracked by the GPS receivers and shall be low-profile units housed in rugged, weather tight, roof-mounted enclosures.   | H        |
| R3.7.9.6.12 | The GPS antennas shall be designed to disconnect from the GPS antenna cable at the point where the antenna is mounted to the roof so that the Owner maintenance personnel may remove the GPS antenna without having to remove the GPS antenna cable from the vehicle.         | H        |

### 3.7.9.7 Automatic Passenger Counting System

The Owner prefers designs that allow dwell times at bus stops to be calculated, based on “door open” and “door close” indications.

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.7.9.7.1  | The Contractor shall provide all APC hardware, software, and services required to implement APC functionality on each of the Owner’s fixed route buses.  | H        |
| R3.7.9.7.2  | The APC equipment shall include all sensors, wiring, cabling, and installation hardware required to make the APCs fully functional on the Owner’s vehicle.   | H        |
| R3.7.9.7.3  | The Contractor shall provide all hardware and software required to count passengers; collect, store, and transmit the APC data; perform post-processing on the data; and analyze and generate reports on the APC data.                               | H        |
| R3.7.9.7.4  | The number of buses to be equipped with APC equipment is defined in Appendix B.  | H        |
| R3.7.9.7.5  | The APC sensors provided to detect passengers boarding and alighting shall use sensors that have a proven high level of reliability and accuracy, and are easily serviced.   | H        |
| R3.7.9.7.6  | APC sensors shall be provided for each door on the designated buses.   | H        |
| R3.7.9.7.7  | The installed locations of the APC sensors shall be subject to Owner approval.   | H        |
| R3.7.9.7.8  | The APC system shall include all equipment required to interface the APC subsystem with the other Contractor-provided on-board vehicle equipment to allow the passenger counts to be correctly associated with the AVL-based location and bus stops. | H        |
| R3.7.9.7.9  | The Contractor shall interface to existing door open and door close contacts for the vehicles being equipped with APC equipment.   | H        |
| R3.7.9.7.10 | Unless otherwise approved by the Owner, the Contractor shall interface to the door contact indicating the start of the door opening and the contact indicating door closure completion.  | H        |
| R3.7.9.7.11 | If supported, dwell time data shall be reported as part of the APC data for each stop.   | H        |
| R3.7.9.7.12 | APC data shall be uploaded from the buses to the System at the end of the vehicle’s daily service period.  | H        |
| R3.7.9.7.13 | APC data for each bus stop shall be reported to the System and stored in the System database along with the time that the bus departed the bus stop.   | H        |
| R3.7.9.7.14 | The bus stop departure times shall be accurate to hours, minutes, and seconds.   | H        |

### 3.7.9.8 Automated Next Stop Announcement and Display System

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.7.9.8.1 | The Contractor shall provide a fully automatic next stop audio announcement and visual display system for the Owner’s buses listed in Appendix C. | H        |

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.7.9.8.2  | The Contractor shall provide all on-board bus equipment and all equipment required to load the audio and visual messages into the on-board bus equipment.  | H        |
| R3.7.9.8.3  | The equipment and software required to generate and modify the audio announcements and visual displays shall be provided by the Contractor (reference Section 3.7.12).   | H        |
| R3.7.9.8.4  | The Contractor-provided automated stop announcement and display system shall meet or exceed all ADA requirements in 49CFR Parts 37.167 and 38.35.  | H        |
| R3.7.9.8.5  | The automated next stop audio announcement and visual display system shall interface with the other on-board equipment via an SAE J1708/J1587 or J1939 interface.  | H        |
| R3.7.9.8.6  | The Contractor's design shall support all of the routes in the Owner's service territory and all the runs made by each bus during a service day.   | H        |
| R3.7.9.8.7  | Scheduled day-to-day variations in routes, variations in runs on the same route, and scheduled stops (including interlined stops) shall be supported by the Contractor's design.   | H        |
| R3.7.9.8.8  | No vehicle operator intervention besides log-in shall be required to ensure that the audio announcements and visual displays are properly correlated with the route and stops defined in the schedule.   | H        |
| R3.7.9.8.9  | If a bus goes off-route, the automatic audio announcements and visual displays for the route shall be suspended.   | H        |
| R3.7.9.8.10 | The audio announcements and visual displays shall automatically resume, without vehicle operator intervention, when the bus returns to the route, even if the bus returns to the route at a different point than where it went off-route.  | H        |
| R3.7.9.8.11 | All the audio and visual messages required for all the Owner routes and schedules shall be stored in non-volatile memory devices in the on-board automated announcement and display equipment.   | H        |
| R3.7.9.8.12 | It shall not be necessary to update or download the audio and display message and route data to the buses except for the three or four times a year that the Owner updates their schedules and routes.   | H        |
| R3.7.9.8.13 | The method used for downloading new message and route data shall allow all buses in the Owner's fleet to be updated with new data within a few hours so that the change-over may be accomplished after buses return to the base at the end of their service day and prior to beginning their next service day. | H        |
| R3.7.9.8.14 | Unsuccessful downloads shall be reported by the System and system users shall be able to determine to which buses the new data has been downloaded and which buses still require a data download.  | H        |
| R3.7.9.8.15 | No more than 60% of the memory provided on-board the buses for storing the digitally-recorded announcements and display messages shall be required for recording the next stop, major intersection, and key transfer point announcements and display messages in both English and Spanish.                     | H        |
| R3.7.9.8.16 | The remaining 40% of installed memory shall accommodate future expansion and the storage of promotional, public service, advertising announcements, and display messages.  | H        |

| ID          | Requirement   | Priority |
|-------------|---|----------|
| R3.7.9.8.17 | The display of messages outside the buses will not be required; however, the Contractor's design shall support the future addition of displays to passengers boarding the buses.  | H        |
| R3.7.9.8.18 | The annunciation of messages outside the bus to passengers boarding the bus shall be provided.  | L        |
| R3.7.9.8.19 | External announcements shall be triggered when the bus doors open at a stop.  | L        |
| R3.7.9.8.20 | The Owner shall be able to define external audio announcements and future visual displays that are different from the internal audio and visual messages so that boarding passengers can be provided with route and destination information.  | L        |
| R3.7.9.8.21 | Simultaneous internal and external announcements and displays shall be supported.   | L        |
| R3.7.9.8.22 | In addition to the location-based announcements and displays, the automated stop announcement and display system shall support the display and annunciation of messages to be made at specified times of day and at specified time intervals throughout the day.  | L        |
| R3.7.9.8.23 | The Owner shall be able to define a minimum of 100 special public information, advertising, or similar messages that are to be announced and/or displayed at specific times of the day or at specified time intervals.  | L        |
| R3.7.9.8.24 | The automatic audio announcement equipment to be provided by the Contractor shall enable digitally-recorded information to be automatically announced to passengers on-board the buses based on the bus's System derived location on the defined run/block, time of day, and door opening activities.   | H        |
| R3.7.9.8.25 | The types of information to be supported shall include audible annunciation of next stops, major intersections, key transfer points, cautionary boarding and unloading warnings, serviced route, promotional information, public service information, and advertising.  | H        |
| R3.7.9.8.26 | The Contractor-provided equipment shall be able to record and annunciate sounds covering the full range of human hearing including spoken voice, music, and sound effects.  | H        |
| R3.7.9.8.27 | The audio announcement equipment to be provided by the Contractor and installed on buses by the Owner shall include all equipment necessary for downloading the announcements to the buses, storing the announcements on-board the buses, and announcing the announcements to the passengers on-board the buses using the existing PA system. | H        |
| R3.7.9.8.28 | The installed audio announcement equipment shall provide high-quality audio output of the recorded messages that is easily understandable to passengers on the bus.   | H        |
| R3.7.9.8.29 | The vehicle operator PA announcements shall override Automatic audio announcements.   | H        |
| R3.7.9.8.30 | The System shall be equipped to synchronize the automatic audio announcements with the on-board visual display equipment so that the same information is concurrently presented to the passengers by both audio and visual means.   | H        |
| R3.7.9.8.31 | Vehicle operators shall not be able to enable/disable the audio announcements, except by going out of service.  | H        |
| R3.7.9.8.32 | The automatic visual display equipment to be provided by the Contractor shall enable information to be automatically displayed to passengers on-board the buses based on the bus's System derived location on the defined route/run, time of day, and door opening activities.  | H        |

| ID          | Requirement   | Priority |
|-------------|---|----------|
| R3.7.9.8.33 | The types of information to be supported shall include display of next stops, major intersections, key transfer points, promotional information, public service information, and advertising.   | H        |
| R3.7.9.8.34 | The Contractor-provided equipment shall be able to display alphanumeric and graphical information.  | H        |
| R3.7.9.8.35 | For LED-based visual displays, the graphical information shall consist of displaying non-alphanumeric characters, symbols, and similar LED images.  | H        |
| R3.7.9.8.36 | The Owner shall be able to define how each message is displayed.  | H        |
| R3.7.9.8.37 | Means shall be provided to allow messages to be flashed, streamed, and displayed in single frame mode.  | H        |
| R3.7.9.8.38 | All display time periods, delays, and rates shall be adjustable. Automatic centering of messages shall be supported.  | H        |
| R3.7.9.8.39 | Multi-lingual support shall be provided to enable the Owner to define and display all messages in at least English and Spanish.   | H        |
| R3.7.9.8.40 | The visual display equipment shall include all equipment necessary for downloading the display information to the buses, storing the displays on-board the buses, and displaying the information to the passengers on-board the buses.  | H        |
| R3.7.9.8.41 | The Contractor shall provide cabling and mounting brackets to install the visual display equipment in the Owner approved locations on the buses where the display unit will not interfere with passengers, the vehicle operator, and the vehicle operator's view through the front or side windows. | H        |
| R3.7.9.8.42 | If possible, the visual display shall be mounted behind the vehicle operator's seated position such that all or most of the passengers can view the display from their seated or standing positions.  | H        |
| R3.7.9.8.43 | If the visual display equipment mounting location obscures or replaces the "Stop Requested" sign, the next stop visual display equipment shall display the text "Stop Requested" whenever a stop request has been made and no other messages are being displayed.                                   | H        |
| R3.7.9.8.44 | One display unit shall be provided and installed on each bus.   | H        |
| R3.7.9.8.45 | The visual displays shall be high-contrast displays that are clearly readable in the full range of lighting conditions found on the Owner's buses.  | H        |
| R3.7.9.8.46 | The installed displays shall be clearly readable by passengers with 20/30 vision when the passengers are seated at the rear of the bus.   | H        |
| R3.7.9.8.47 | The Contractor-provided visual displays shall be at least 14-character wide displays supporting character heights of at least two inches.   | H        |

### 3.7.9.9 Wireless LAN Interface (Optional)

If a wireless LAN is used for bulk data transfer between the vehicles and the System, the wireless LAN equipment must meet the following requirements.

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.7.9.9.1 | The supplied LAN equipment shall be Ethernet conforming to the IEEE 802.11g series standards.  | L        |
| R3.7.9.9.2 | Wireless LAN antennas shall be mounted on-board the vehicles in locations where they will be protected from damage during normal operations and where they do not interfere with the seated vehicle operator's view out the windows. | L        |

### 3.7.9.10 Other Device Interfaces

| ID          | Requirement  | Priority |
|-------------|--|----------|
| R3.7.9.10.1 | The vehicle communication gateway shall be interfaced to other on-board devices that do not reside on the VAN.   | L        |
| R3.7.9.10.2 | The Contractor shall provide the input capabilities required to connect existing on-board devices to the System on-board equipment.  | L        |
| R3.7.9.10.3 | The types of equipment to be interfaced to the System are as follows: <ul style="list-style-type: none"> <li>a. Door sensor status contacts</li> <li>b. Snow plow position (up/down)</li> <li>c. Engine and transmission status contacts</li> <li>d. Wheelchair lifts/ramps status contacts</li> <li>e. Spare status contact inputs</li> </ul> | L        |

### 3.7.9.11 Future On-Board Vehicle Equipment and Interfaces

The System and on-board vehicle equipment provided by the Contractor shall be designed such that they are capable of being interfaced to additional "smart-bus" electronic equipment in the future.

### 3.7.10 Base Wireless LAN (Optional)

If a wireless LAN is used for bulk data transfer between the vehicles and the System, the wireless LAN equipment must meet the following requirements.

| ID        | Requirement   | Priority |
|-----------|---|----------|
| R3.7.10.1 | The Contractor shall supply, and test all wireless LAN equipment required to upload data from and download data to revenue and non-revenue vehicles located at the base.                          | L        |
| R3.7.10.2 | The Contractor shall verify that the coverage between the wireless LAN access points overlaps such that the loss of a single wireless LAN access point does not cause a coverage area to be lost. | L        |
| R3.7.10.3 | The Contractor shall ensure that the wireless LAN is not subject to, or cause, interference with other communications present at or near the base.  | L        |
| R3.7.10.4 | The Contractor shall ensure that appropriate security measures are implemented to safeguard all wireless LAN interfaces from unauthorized access.   | L        |

| ID        | Requirement   | Priority |
|-----------|---|----------|
| R3.7.10.5 | The wireless LAN interfaces and the wireless LAN security measures shall be subject to Owner approval.                                  | L        |
| R3.7.10.6 | The Owner will review the Contractor's proposed System LAN authentication protocol requirements and other design elements.              | L        |
| R3.7.10.7 | The installation locations of all wireless LAN access points and other wireless LAN equipment shall be subject to the Owner's approval. | L        |
| R3.7.10.8 | The Contractor shall be responsible for cabling to the wireless LAN equipment.  | L        |

### 3.7.11 Other Peripheral Devices

The Contractor shall supply all peripheral devices or equipment required for the operation, software support, or maintenance of the System.

### 3.7.12 Maintenance Equipment for Next Stop Announcement System

The Owner prefers design approaches that minimize the effort involved in generating, updating, and downloading audio and visual messages. Design approaches such as automatically generating voice announcements from text are acceptable, provided the required high audio quality and clarity is achieved.

| ID        | Requirement   | Priority |
|-----------|---|----------|
| R3.7.12.1 | The Contractor shall provide the hardware and software for defining and modifying the audio and visual messages and downloading these messages to the buses in a convenient and user-friendly manner.   | H        |
| R3.7.12.2 | Users shall be able to define the audio and video messages as well as the locations where the messages are to be issued and the characteristics of the messages.  | H        |
| R3.7.12.3 | The System shall be equipped to allow users to reuse messages for multiple routes and trips so that repetitive definition of the same message is not required for each route or trip requiring the same audio or visual message.              | H        |
| R3.7.12.4 | The System shall be equipped to allow users to review the audio and visual announcements in sequence on each route.   | H        |
| R3.7.12.5 | One complete set of audio and visual message definition and review equipment and software shall be provided at the Owner facility and interfaced to the System LAN.   | H        |
| R3.7.12.6 | The audio announcement, display definition, and update equipment and software shall support all of the functions and features of the automated next stop annunciation and display system equipment.   | H        |
| R3.7.12.7 | The System shall be equipped for recording announcements and shall enable the Owner to incorporate commercially available music and sound effects, in industry standard formats, into public service, advertising, and similar announcements. | H        |

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.7.12.8  | The visual messages shall be definable to be in synchronization with the corresponding audible announcements such that the same information is concurrently presented to the passengers by both audio and visual means. | H        |
| R3.7.12.9  | The display definition and maintenance functions of the System shall support both text and graphic displays.  | H        |
| R3.7.12.10 | Utilities shall be provided to support the importation of appropriate data (e.g., bus stop names, location, and route definitions) from the bus stop and schedule databases.  | H        |

### 3.8 Documentation

| ID      | Requirement   | Priority |
|---------|---|----------|
| R3.8.1  | Complete documentation for the System shall be provided to the Owner.   | H        |
| R3.8.2  | Each project specific document shall be identified by a unique Contractor document number and Owner contract number.  | H        |
| R3.8.3  | Where a document is revised for any reason, each such revision shall be indicated by a number, date, and subject in a revision block.   | H        |
| R3.8.4  | Appendix C summarizes the deliverable documentation requirements including the number of document copies to be submitted for review, as preliminary documentation, and as final documents.      | H        |
| R3.8.5  | The Contractor shall provide an index of all System documentation, identifying all documents to be provided with the System. The index shall describe each document and the document's purpose. | H        |
| R3.8.6  | Electronic copies of all documents shall be provided to the Owner in Adobe PDF format.  | H        |
| R3.8.7  | Electronic copies shall be delivered on a CD or e-mailed to up to five Owner-designated personnel.  | H        |
| R3.8.8  | The Owner shall have the right to reproduce all documentation provided by the Contractor for this project.  | H        |
| R3.8.9  | The Owner shall have the right to distribute any documentation to any authorized user.  | H        |
| R3.8.10 | Options included in the documents, which are not provided under this Contract, shall be marked "not used".  | H        |

#### 3.8.1 System Functional Description Document

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.8.1.1 | A system functional description document shall be provided that contains a high-level definition of the specific System hardware, software, and firmware and the functions performed by each. | H        |
| R3.8.1.2 | The system functional description document shall serve as a complete introduction to the System and to the more specific hardware and software documents.                                     | H        |



| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.8.1.3 | <p>The following information shall be included in the system functional description document:</p> <ol style="list-style-type: none"> <li>An overview of the hardware configuration showing all major hardware subsystems</li> <li>The overview shall include block diagrams in sufficient detail to show the interrelationships of major hardware subsystems and the elements that comprise them</li> <li>A description of the major hardware subsystems, the elements that comprise them, their interrelationships, and the functions they perform</li> <li>An overview of the major software subsystems describing the software, the interrelationship of software within a subsystem, and the relationship between subsystems</li> <li>The subsystems to be described shall include the AVL, operating system, network software, system interfaces, historical storage, support utilities, database, map, and report generation</li> <li>A complete description of the software and the individual functions performed by the software shall be provided</li> <li>Significant features, concepts, and algorithms pertaining to each function shall be described with special emphasis on equipment, software, and features unique to the System</li> </ol> | H        |

### 3.8.2 Hardware Documentation

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.8.2.1 | Documentation for all supplied System hardware shall be provided to the Owner.  | H        |
| R3.8.2.2 | The Contractor shall provide the Owner with all documentation originally supplied with standard OEM hardware devices purchased from others.   | H        |
| R3.8.2.3 | <p>The Contractor shall provide the following documentation:</p> <ol style="list-style-type: none"> <li>Inventory of all hardware to be supplied, including the manufacturer's name, model number, serial number, nameplate data, overall dimensions, and quantities</li> <li>Spare parts shall be part of the inventory</li> <li>Site floor plans indicating rack, cabinet, and peripheral device locations and sizes for the computer room</li> <li>The locations and sizes of all equipment to be mounted in each rack, cabinet, and console shall be identified</li> <li>The site floor plans shall depict the location of all new equipment with reference to the existing equipment</li> <li>Horizontal and vertical cable and conduit runs shall be shown as well as equipment mounting details, wall/floor/roof penetrations and sealing details</li> <li>Detailed installation wiring and cabling diagrams shall be provided showing all connections to all equipment</li> <li>Any special precautions associated with cabling shall be clearly identified</li> <li>All Owner cable and wiring terminations shall be shown on drawings, and all terminal markings, cable connector markings, cable lengths, power distribution depicting voltage source, and grounding scheme shall be clearly indicated</li> <li>The Owner will furnish prints, if available, of wiring diagrams for existing equipment</li> <li>If the existing wiring diagrams are unavailable, the Contractor shall survey the existing wiring in the field to obtain information required for circuit design and drafting efforts</li> <li>Configuration block-diagrams showing all System equipment and interconnections between System components and Owner systems, devices, and facilities</li> </ol> | H        |

| ID        | Requirement  | Priority |
|-----------|--|----------|
| R3.8.2.4  | The Contractor shall provide detailed drawings showing System equipment and wiring installations on each type of vehicle being equipped with System equipment by the Contractor.   | H        |
| R3.8.2.5  | Separate sets of drawings shall be provided for each type of vehicle.  | H        |
| R3.8.2.6  | The level of detail provided on the drawings shall be sufficient for use by the System equipment installation personnel.   | H        |
| R3.8.2.7  | The information to be included on the vehicle drawings shall include: <ul style="list-style-type: none"> <li>a. Block diagrams showing all on-board System equipment, related existing vehicle equipment, and all interconnections</li> <li>b. System equipment dimensions, mounting locations, mounting details, distances to existing vehicle equipment, installation instructions, and any modifications or relocating of existing vehicle equipment or components</li> <li>c. Overview drawings showing the overall layout of the vehicle and the locations of all System equipment</li> <li>d. Detailed wiring and cabling diagrams showing all System wiring and cabling, terminal connections, power connections, grounding details, routing details, connections to existing wiring, and any planned modifications or rerouting of existing wiring and cabling</li> <li>e. Antenna mounting locations and details, including the locations and distances from existing antennas</li> <li>f. Drawings showing the airbag deployment zone for all airbags installed in airbag equipped vehicles and the clearances of all System equipment to the airbag deployment zone(s)</li> </ul> | H        |
| R3.8.2.8  | Physical planning and site preparation manuals shall be provided for all System hardware.  | H        |
| R3.8.2.9  | The manuals shall contain: <ul style="list-style-type: none"> <li>a. Drawings of all racks, cabinets, enclosures, consoles, computer equipment, power supply equipment, and communications equipment</li> <li>b. Mounting details, clearance requirements, and environmental restrictions</li> <li>c. Electrical power supply requirements</li> <li>d. Heat dissipation specifications</li> <li>e. Device installation requirements</li> </ul>   | H        |
| R3.8.2.10 | Reference manuals shall be provided for all hardware.  | H        |
| R3.8.2.11 | Reference manuals shall include documentation relating to System hardware, including descriptions, specifications, theory of operation, installation information, and drawings.  | H        |
| R3.8.2.12 | The Contractor shall include an attachment to each document outlining those portions of the document, if any, that do not apply to the Owner hardware.   | H        |
| R3.8.2.13 | Hardware user manuals shall be provided where applicable.  | H        |
| R3.8.2.14 | Manuals and other descriptive material shall be provided for all Contractor-provided equipment that is to be maintained by the Owner, regardless of whether the equipment is manufactured by the Contractor or another supplier.   | H        |
| R3.8.2.15 | Hardware documentation shall include all the information the Owner needs to perform the planned level of maintenance.  | H        |
| R3.8.2.16 | The manuals shall provide guidelines for isolating the causes of hardware malfunctions and for localizing faults.  | H        |

| ID        | Requirement  | Priority |
|-----------|--|----------|
| R3.8.2.17 | Complete parts lists and breakdowns with sufficient descriptions to identify each field-replaceable component shall be provided.   | H        |
| R3.8.2.18 | Where applicable, instructions shall be provided for preventive maintenance procedures that include examinations, tests, adjustments, and periodic cleaning.   | H        |
| R3.8.2.18 | Diagnostic program users manuals shall be provided with complete instructions on the loading and operation of all hardware diagnostic programs required for the level of equipment maintenance to be performed by the Owner. | H        |
| R3.8.2.20 | The user manuals shall include guides for locating faults, symptoms, possible causes of trouble, and suggested remedial action.  | H        |
| R3.8.2.21 | Sample printouts from the diagnostic programs shall be included in the user manual.  | H        |

### 3.8.3 Software Documentation

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.8.3.1 | Documentation for all supplied System software shall be provided to the Owner.   | H        |
| R3.8.3.2 | In addition to the documentation specifically identified below, the Contractor shall provide the Owner with all documentation originally supplied with standard OEM software purchased from others.  | H        |
| R3.8.3.3 | Existing documentation and user manuals for standard software shall be provided.   | H        |
| R3.8.3.4 | Standard software is defined as field-proven software purchased from third-parties or software developed internally as a base for all projects, that fully satisfies the requirements of the Specification without modification for the Owner. | H        |
| R3.8.3.5 | Standard software includes operating systems, software diagnostic programs, network managers, and window managers.   | H        |

### 3.8.4 Interface Definition Documentation

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.8.4.1 | An interface definition document shall be provided for each interface to an external computer, describing protocols, message structures, and individual field formats. | L        |

### 3.8.5 Firmware Documentation

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.8.5.1 | If the Contractor implements certain functions in firmware, that firmware shall be documented in conformance with the software documentation requirements. | L        |

### 3.8.6 Database Documentation

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.8.6.1 | Database documentation shall be provided that describes the structure of the System and historical databases.                  | H        |
| R3.8.6.2 | The documentation shall define the individual elements (files, records, fields, and tables) that comprise the databases.       | H        |
| R3.8.6.3 | Portions of the database developed specifically for the System shall be identified.  | H        |
| R3.8.6.4 | User documentation for the database management system or database access routine utilized by the Contractor shall be supplied. | H        |

### 3.8.7 System Dispatcher/Supervisor User Manual

| ID        | Requirement   | Priority |
|-----------|---|----------|
| R3.8.7.1  | A System User Manual shall be provided that contains detailed operating instructions and procedures for system users.   | H        |
| R3.8.7.2  | Information in the System User Manual shall be presented in terms that are meaningful to system users.  | H        |
| R3.8.7.3  | The System User Manual shall include a description of the operation of the System hardware and software as it relates to system user's tasks.   | H        |
| R3.8.7.4  | The System User Manual shall be customized for the Owner and shall be based on the delivered System.  | H        |
| R3.8.7.5  | It is not acceptable to describe the Contractor's standard system and then identify differences between the standard and delivered System.  | H        |
| R3.8.7.6  | The System User Manual shall not include standard or optional descriptions that do not apply to the delivered System.   | H        |
| R3.8.7.7  | The System User Manual shall describe each function and how it is to be used.   | H        |
| R3.8.7.8  | The System User Manual shall not be written as a programmer's document.   | H        |
| R3.8.7.9  | Procedures shall be explained in a step-by-step manner with an explanation of how each step is performed, which parameters can be adjusted, and the effects obtained by varying each parameter. | H        |
| R3.8.7.10 | All user guidance and error messages shall be described, along with the steps necessary to recover from errors.   | H        |
| R3.8.7.11 | Each system function defined in this specification and all other functions, features, and operations accessible to system users shall be included in this manual.                               | H        |
| R3.8.7.12 | User instructions for each display shall be provided along with images of each display. Each data field shall be described.   | H        |

### 3.8.8 System Administrator User Manual

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.8.8.1 | Administrator-oriented system documentation shall be provided to guide the Owner personnel in the operation and procedures required to maintain and update the System, including system software and firmware, database, application software, and other elements of the System.   | H        |
| R3.8.8.2 | The System Administrator Manual shall describe procedures to be followed as a result of computer system restarts, failures, and failovers.   | H        |
| R3.8.8.3 | The System Administrator Manual shall have sufficient information to guide system administrator on how to restart and reconfigure the System.  | H        |
| R3.8.8.4 | System Administrator documents shall be provided for the following items: <ul style="list-style-type: none"> <li>a. Processor configuration</li> <li>b. System performance monitoring and tuning</li> <li>c. System start-up, shut-down, and restart failover management</li> <li>d. Diagnostic procedures</li> <li>e. System management including supervisor commands</li> <li>f. Database management, including maintenance, backup, and restoration procedures</li> <li>g. Report generation and management</li> <li>h. GIS management</li> <li>i. Data interface/loading procedures</li> <li>j. Diagnostic programs</li> <li>k. Software utilities</li> <li>l. All other Contractor-supplied system software not included above</li> </ul> | H        |

### 3.8.9 Vehicle Operator User Manual

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.8.9.1 | The Contractor shall provide a Vehicle Operator Manual that explains the design, functional operation, and detailed operating instructions on all of the Contractor-provided equipment to be installed on-board the Owner's vehicles. | H        |
| R3.8.9.2 | All of the features, functions, operations, and displays of the System equipment installed in the vehicles shall be explained and illustrated in detail.  | H        |
| R3.8.9.3 | The Vehicle Operator Manual shall be customized for the Owner and shall be based on the delivered System equipment.   | H        |
| R3.8.9.4 | It is not acceptable to describe the Contractor's standard equipment and then identify differences between the standard and delivered System equipment.   | H        |
| R3.8.9.5 | Information in the manual shall be presented in terms that are meaningful to the Owner vehicle operators.   | H        |
| R3.8.9.6 | The operation of the System equipment shall be explained as it relates to the vehicle operator's tasks.   | H        |

| ID        | Requirement  | Priority |
|-----------|--|----------|
| R3.8.9.7  | Procedures shall be explained in a step-by-step manner with an explanation and illustration of how each step is performed, how the displayed information changes in response to each step or action, what data can be entered, what controls are available, and the effects obtained by data entry, display selection, function selection, and controls. | H        |
| R3.8.9.8  | All push buttons, soft keys, and other control and selection mechanisms shall be explained and all displays that the vehicle operators will be able to access shall be explained and accurately illustrated.   | H        |
| R3.8.9.9  | All user guidance and error messages shall be described, along with the steps necessary to recover from errors.  | H        |
| R3.8.9.10 | Procedures and operations that are only applicable to maintenance personnel shall be defined separately from the Vehicle Operator Manual.  | H        |
| R3.8.9.11 | A draft of the Vehicle Operator Manual shall be provided to the Owner for the preliminary design review.   | H        |
| R3.8.9.12 | The final Vehicle Operator Manual shall be delivered to the Owner at least two months prior to the start of the Owner's first vehicle operator training course.  | H        |
| R3.8.9.13 | The final Vehicle Operator Manual shall be provided in electronic format so that the Owner can modify the document as needed in the future.  | H        |

### 3.8.10 Document Quantities

| ID        | Requirement  | Priority |
|-----------|--|----------|
| R3.8.10.1 | The quantities of documents to be supplied for review, preliminary, and final documents are enumerated in Appendix C.              | H        |
| R3.8.10.2 | Electronic copies of all documents shall be provided to the Owner each time the review, preliminary, or final document is updated. | H        |
| R3.8.10.3 | Electronic versions of documents shall be provided in Adobe PDF format.  | H        |
| R3.8.10.4 | In addition, final documents shall be provided in a commercially available word processing format such as Microsoft Word.          | H        |

## 3.9 Training, Support, and Maintenance

### 3.9.1 Training

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.9.1.1 | The Contractor shall provide a comprehensive training program that prepares the Owner's personnel for operation and general support of the System. | H        |
| R3.9.1.2 | Training may be conducted by the Contractor, the Contractor's Subcontractors, third-party software suppliers, and OEMs.                            | H        |

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.9.1.3 | The training requirements of this Specification shall apply to courses taught by Subcontractors, third parties, and OEMs, as well as to courses taught by the Contractor. | H        |
| R3.9.1.4 | The Contractor shall provide to the Owner all training credits supplied to the Contractor by Subcontractors, third parties, and OEMs.                                     | H        |

### ***3.9.1.1 Dispatch Center Personnel Training***

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.9.1.1.1 | The Contractor shall train dispatch center personnel and the Owner-selected training instructors in the functional capabilities of the System and in the operation of the System workstations and other console equipment.   | H        |
| R3.9.1.1.2 | The dispatch center personnel course shall provide a thorough understanding of the operation and user interface requirements of all System functions and shall familiarize dispatch center personnel and the Owner training instructors with general System and radio system design concepts and features. | H        |
| R3.9.1.1.3 | The operation and functionality of the on-board vehicle equipment shall be covered in this course so that dispatch center personnel are familiar with the equipment and functions available to the vehicle personnel.  | H        |
| R3.9.1.1.4 | Dispatch center personnel training shall include hands-on training using the actual hardware and software being delivered to the Owner.  | H        |
| R3.9.1.1.5 | Training aids for this course shall include the System User Manual and Vehicle Operator User Manual.   | H        |

### ***3.9.1.2 Vehicle Operator Instructor Training***

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.9.1.2.1 | The Contractor shall train selected Owner training personnel to be qualified instructors in the operation of the System on-board vehicle equipment supplied by the Contractor.   | H        |
| R3.9.1.2.2 | The instructor training course shall provide a thorough and clear presentation of the user interface to the on-board vehicle equipment and shall include hands-on training using the actual on-board vehicle hardware and software being delivered to the Owner.                                 | H        |
| R3.9.1.2.3 | The instructor training course shall instruct Owner training personnel on the setup, operation, and configuring of the vehicle operator training sets of on-board equipment to be provided by the Contractor for the Owner's use as vehicle operator training aids, as defined in Section 3.7.8. | H        |

### 3.9.1.3 System Administrator Training

| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.9.1.3.1 | The system administrator training courses shall provide training on the procedures necessary to configure, operate, and maintain the System in an efficient, controlled, and well-documented manner.   | H        |
| R3.9.1.3.2 | <p>The system administrator training courses shall include, but not be limited to, training in:</p> <ul style="list-style-type: none"> <li>a. The structure, interfaces, and functions of the System software and databases</li> <li>b. System backup and restoration procedures, including disaster recovery procedures if Owner's servers are not used</li> <li>c. Generating, deleting, modifying, and installing reports in the real-time environment, including the use of ad hoc queries</li> <li>d. Linkages to the database and application software</li> <li>e. Generation and modification of typical Owner reports</li> <li>f. Installing software updates provided by the Contractor and third-party software suppliers</li> <li>g. Using the software configuration management and administration tools</li> <li>h. Interpreting and responding to messages generated by all error-monitoring software</li> <li>i. Maintaining and tuning the databases using database management tools</li> <li>j. Updating fixed-route schedules and other data that is imported into the System</li> <li>k. Updating the map database by importing revised base maps, routes, bus stops, etc.; and distributing these map updates to all map-equipped workstations</li> <li>l. Managing the historical data archive facility</li> <li>m. Performing maintenance of route, schedule, vehicle, bus stop, time point, vehicle operator, and similar data within the System</li> <li>n. Using the operating system(s) and network administration facilities</li> <li>o. Adding, deleting, and modifying entries in the list of valid System users, their levels of authorization, and their passwords</li> </ul> | H        |
| R3.9.1.3.3 | The System Administration course shall include overview-level training on the structure, organization, and functionality of the system software, application software, and database to allow system administration personnel to effectively support maintenance contracts for the System.  | H        |

### 3.9.1.4 Vehicle Equipment Support Training

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.9.1.4.1 | System hardware support training courses shall be provided for all Contractor provided System equipment to be installed at the Owner's computing facilities, on-board the Owner vehicles, at the base, and at other remote locations. | H        |
| R3.9.1.4.2 | The System hardware support training shall provide the Owner personnel with a working knowledge of the System hardware, its control, its operation, associated interfaces, and operation of diagnostic tools.                         | H        |
| R3.9.1.4.3 | Training for the fixed-end equipment shall be conducted separately from the training for System vehicle equipment.  | H        |
| R3.9.1.4.4 | In the case of the fixed-end equipment training, the courses shall provide the Owner support personnel with an overall knowledge in the trouble isolation procedures.   | H        |



| ID         | Requirement  | Priority |
|------------|--|----------|
| R3.9.1.4.5 | Support training courses are not intended to train the Owner personnel in the actual detailed troubleshooting and repair of System hardware but rather to provide an understanding in the above topics so that the trained Owner personnel may properly manage System warranty and maintenance contracts and oversee the work performed by maintenance contractors.  | H        |
| R3.9.1.4.6 | In the case of the vehicle equipment, trainees shall be trained on: <ul style="list-style-type: none"> <li>a. equipment operation</li> <li>b. trouble isolation techniques</li> <li>c. diagnostics, and other topics that will enable vehicle electronic equipment maintenance personnel to: <ul style="list-style-type: none"> <li>1. isolate System problems to field replaceable units</li> <li>2. properly remove and install System components</li> <li>3. perform any required adjustments or routine maintenance</li> </ul> </li> </ul> | H        |

### 3.9.1.5 Report Generation Training

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.9.1.5.1 | This course shall provide in-depth training in the generation and modification of System reports and ad-hoc queries.  | M        |
| R3.9.1.5.2 | Generic, third party, training on the general capabilities of the database and reporting software provided in the System is acceptable as the initial introduction to the System's reporting capabilities, provided it is supplemented with System-specific training. | M        |
| R3.9.1.5.3 | The report generation training course shall include hands-on training on the System and the specific reports being provided with the System.  | M        |
| R3.9.1.5.4 | Trainees shall receive instruction on the basic operation of the System, how and when data is gathered, and the types of data available in the System.  | M        |
| R3.9.1.5.5 | At the completion of the report training course, trainees shall be able to modify existing System reports, generate new System reports, and produce ad-hoc database queries.  | M        |

### 3.9.1.6 Supplemental Training

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.9.1.6.1 | The Contractor shall provide extended, duplicate, or additional training for the System as deemed necessary by the Owner because of the following occurrences: <ul style="list-style-type: none"> <li>a. Major modifications to either System hardware or software, made after completion of the scheduled training courses, that were necessary to meet the requirements of this Specification</li> <li>b. Delays in placing the System into revenue service for which the Contractor is responsible and that result in more than six months elapsing between completion of one or more training courses and the placing of the System into revenue service</li> </ul> | L        |
| R3.9.1.6.2 | Supplemental training shall be supplied at no cost to the Owner.  | L        |

| ID         | Requirement   | Priority |
|------------|---|----------|
| R3.9.1.6.3 | The Owner will determine the time, location, and extent of any supplemental training in consultation with the Contractor. | L        |

### 3.9.2 Spare Parts and Test Equipment

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.9.2.1 | The Contractor's proposal shall include a recommended list of spare parts for the System, and these spare parts shall be included in the System price.   | L        |
| R3.9.2.2 | All special test equipment, and other special devices necessary to troubleshoot, maintain, diagnose, and repair System equipment that the Owner will be maintaining shall be provided by the Contractor and will be owned by the Owner.  | L        |
| R3.9.2.3 | Fully assembled spare devices shall be supplied for the on-board vehicle equipment provided by the Contractor.   | L        |
| R3.9.2.4 | Due to anticipated fleet expansion and the ongoing need for maintenance spare parts, the Owner requires that spare parts, or backward-compatible replacement parts for System equipment, be available for purchase by the Owner for at least 10 years after Final Contract Acceptance of the System. | L        |
| R3.9.2.5 | If at any time, the Contractor, or a supplier to the Contractor, plans to discontinue manufacturing any of the System devices or parts provided to the Owner, the Contractor shall notify the Owner accordingly.   | L        |
| R3.9.2.6 | The Owner shall then have the opportunity to purchase any of the spare parts that are being discontinued that the Owner requires for the System.   | L        |
| R3.9.2.7 | The commercial availability of interchangeable computer equipment such as workstations, servers, monitors, and keyboards is sufficient to meet the above spare parts requirements for these devices, provided no modifications have been made to the devices by the Contractor.                      | L        |
| R3.9.2.8 | All spare parts, special test equipment, and other special devices necessary to troubleshoot and repair the equipment that is supported via maintenance contracts shall be the responsibility of the maintenance Contractor.   | L        |

### 3.9.3 Software Maintenance and Support

| ID       | Requirement   | Priority |
|----------|---|----------|
| R3.9.3.1 | The Owner shall be placed on the Contractor's regular mailing list to receive all software announcements, including announcements of new software releases and other improvements that could be made to the software furnished with the System. | L        |
| R3.9.3.2 | Solutions to problems with Contractor supplied software, whether discovered and corrected on the System or elsewhere, shall be documented and supplied to the Owner without additional charge.  | L        |

| ID       | Requirement  | Priority |
|----------|--|----------|
| R3.9.3.3 | Software maintenance and support service shall include announcements and fixes pertaining to Contractor-produced software for 3 years after final system acceptance, and shall include announcements pertaining to software produced by third-party suppliers for the life of the System warranty. | L        |

## 4 INSPECTION AND TESTING

All materials furnished and all work performed under this specification shall be inspected and tested. Deliverables shall not be shipped until all required inspections and factory tests have been completed; all deficiencies in performance, design or quality have been corrected to the Owner's satisfaction; and until the Owner has approved the hardware and software for shipment.

If any inspections or tests indicate that specific hardware, software, or documentation does not meet the specification's requirements, then the appropriate items shall be replaced, upgraded, or added by the Contractor as necessary to correct the noted deficiencies. After correction of a deficiency, all necessary retests shall be performed to verify the effectiveness of the corrective action.

The Owner's project manager shall be notified in writing at least fifteen (15) business days in advance of each factory test that the Owner personnel will be witnessing. All field-testing shall be coordinated with the Owner's project manager.

All Contractor personnel, including sub-contracted personnel, shall adhere to all of the Owner's employee rules, regulations, and safety procedures while on the Owner's property and vehicles.

### 4.1 *Inspection*

Access to the Contractor's facilities shall be available to the Owner representatives at any time while system manufacturing, factory integration, and testing are taking place and to any facility where hardware or software is being produced for the System.

In conjunction with scheduled project meetings at the Contractor's facilities, the Owner representatives shall be allowed to review and verify the functional implementation of all System software in informal, hands-on demonstrations of the operation of each software function. No special documentation from the Contractor is required to support these informal software demonstrations.

The Owner will perform inspections that include visual examination of hardware, cables, and equipment. Contractor documentation may be examined to verify that it adequately identifies and describes all hardware and software.

The Owner shall not have the inspection rights described above with respect to Subcontractors supplying standard items such as computers or peripheral equipment and third-party software products. Standard hardware and software products shall be tested as part of the Functional Performance Test. However, the Contractor shall require its Subcontractors that are developing unique hardware or software for inclusion in the System to provide the Owner with the inspection rights described above.

## **4.2 System Test Plans and Test Procedures**

Test plans and test procedures for all factory and field tests shall be provided by the Contractor to ensure that each factory and field test is comprehensive and verifies all the features of the functions to be tested. During the development of test plans and test procedures for System application software, special emphasis shall be placed on comprehensively testing each function and feature, checking error conditions, and documenting and verifying the validity of all simulation techniques used. The test procedures shall be modular to allow individual test segments to be repeated as needed.

All test plans and test procedures shall be submitted to the Owner for approval and shall be subject to the approval process. Test plans and test procedures shall meet the requirements of IEEE Std. 829-1998 for Software Test Documentation.

### **4.2.1 System Test Plans**

The System test plans for factory and field tests shall address the testing of all System components and shall be submitted for approval by the Owner before the start of factory testing. No factory or field testing will be conducted until the Owner has approved the test plans.

The following information shall be included in the test plan:

- a. Test schedule
- b. Record-keeping procedures and forms
- c. Procedures for monitoring, correcting, and retesting variances
- d. Procedures for controlling and documenting all changes made to the System after the start of testing
- e. Block diagram(s) of the hardware test configuration during each phase of testing, including Contractor- and Owner-supplied dispatch center equipment, radio equipment, revenue and non-revenue vehicle equipment, external communication channels, and any test or simulation hardware
- f. A comprehensive narrative description of how the testing will be conducted and any functions or features that will not be tested during each phase of testing
- g. A list of individual tests to be performed during each phase of testing and the purpose of each test segment
- h. Identification of special test hardware, software, tools, and equipment to be used
- i. Techniques and scenarios to be used to simulate ultimate system sizing, processor utilization, and performance
- j. Copies of any certified test data (e.g. environmental data) to be used in lieu of testing

#### **4.2.2 System Test Procedures**

System test procedures submitted to the Owner for approval shall be based upon, and consistent with, the approved System test plan. Factory and field test procedures shall be submitted for approval by the Owner prior to the commencement of the respective testing. Testing shall not commence without approved test procedures. The Owner will only approve test procedures if they are inclusive and thoroughly test each System component, both independently and collectively. The test procedures shall include the following items:

- a. Function or feature to be tested
- b. Purpose of each test segment
- c. Set-up and conditions for testing
- d. Procedures to be followed
- e. All inputs and expected results for each test segment
- f. Acceptance criteria for each test segment
- g. Descriptions of all simulation tools and techniques used during the test

#### **4.3 Test Records**

Complete records of all factory and field test results shall be maintained by the Contractor.

The records shall be cross-referenced with the steps enumerated in the test procedures. The following items shall be included in the test records:

- a. Reference to the appropriate section of the test procedures
- b. Test results for each test segment, including a passed/failed indication and any modifications made to the procedures during the test
- c. Identification of the Contractor's test engineer and of the Owner's representative witnessing the test
- d. Date of the test
- e. Provision for comments by the Owner's representative
- f. Copies of any variance reports generated
- g. System logs or printouts saved as part of the test

#### **4.4 Factory Tests**

##### **4.4.1 Reporting of Variances**

Variance reports shall be prepared for any variances discovered between the start of the factory testing through completion of the Final Contract Acceptance of the system. Variance reports shall be prepared each time a deviation from specification requirements, test procedures, or the Contractors design is detected. Variance reports shall be prepared by either Owner or Contractor personnel.

The variance reports shall include a complete description of the variance, including the following items:

- a. A sequential identifying number assigned to the variance
- b. The date and time the variance was first discovered
- c. A detailed description of the variance
- d. Variance classification (Class 1, 2, or 3 – see following paragraph)
- e. Variance status (open, closed, etc.)
- f. Appropriate references to the test procedures and specification or design documentation
- g. A description of the test conditions at the time the variance was detected
- h. Identification of Contractor and the Owner witnesses
- i. Details of what was done to correct the variance, once the variance is resolved
- j. A sign-off by both the Contractor and the Owner when the correction of the variance has been verified, including the date the variance correction was verified

Each variance identified during formal testing shall be assigned by the Owner to one of the following three classes, depending on the severity and impact of the variance on the testing and the System:

**Class 1** - Severe variance that prevents, invalidates, or significantly impairs further testing. Testing will stop for immediate evaluation and correction of the variance by the Contractor.

**Class 2** - Significant variance, but testing will continue and the variance shall be corrected as soon as possible. The impact on testing shall be evaluated and testing will be deferred, rearranged, and repeated as needed.

**Class 3** - Isolated variance that does not impact or invalidate other testing. Testing will continue and the variance will be corrected and tested at a mutually agreed upon time (e.g. at the end of the test, later in the test period, prior to shipment, etc.).

Each variance found outside of the formal testing periods shall be assigned by the Owner to Class 1 (Severe), Class 2 (Significant), or Class 3 (Isolated), depending on the severity and impact of the variance on the System and the Owner operations.

#### **4.4.2 Disposition of Variances**

The Contractor shall document actions taken to correct variances. Sufficient information shall be provided to enable an Owner representative to determine the need for retesting the function, for testing interaction with any previously tested function, and for updating appropriate documentation as a result of the corrective action. Variance corrections that would result in a change to an approved

document must be approved by the Owner prior to their implementation by the Contractor.

Variance reports shall be closed when authorized Contractor and Owner representatives acknowledge, by signatures, correction of the variance. Variance reports shall be available to the Owner at all times. The Contractor shall maintain a variance summary that lists for each variance the variance number, a brief description of the variance, date that the variance was generated, test procedure number (if applicable), variance class, and current status (e.g. open, ready for retesting, closed, etc.), the date the variance was closed, and a brief description of the resolution of the variance. The current variance summary shall be distributed by the Contractor at the completion of each phase of testing, before a new phase of testing, and when requested by the Owner. The variance summary shall be distributed to the Owner in an Owner approved PC-readable electronic format.

#### **4.5 Factory Tests**

Factory tests shall be conducted on the System, including a limited number of sets of the System on-board equipment being provided by the Contractor. The System shall not be shipped until all factory tests are completed to the Owner's satisfaction.

The factory test configuration for the System shall include all non-console System equipment to be installed in the Owner dispatch center, customer information devices, complete sets of vehicle equipment for at least two buses and a complete set of equipment for one non-revenue vehicle. Vehicle equipment shall include radios and all equipment supplied by the Contractor under the System project and means to simulate data signals to and from devices supplied by others or already installed on the vehicles.

The following conditions shall be satisfied prior to the start of the factory tests:

- a. All applicable hardware and software engineering design changes shall be incorporated into the System
- b. System documentation including drawings, a list of deliverables, software functional documents, factory test plans and test procedures, and system user manuals shall have been reviewed and approved by the Owner
- c. All action items related to approval documents, system performance, and test simulation techniques shall be resolved

All testing hardware, software, and special test and measurement equipment required to demonstrate the acceptable operation of the System shall be provided by the Contractor. This includes, but is not limited to radio communications between the on-board vehicle equipment and the fixed-end System equipment, and communications control features. The Contractor shall not substitute equipment during factory tests without prior Owner authorization.

The Factory Test shall consist of a Contractor-performed dry run of the factory tests, formal Owner-witnessed, functional performance testing and unstructured testing by the Owner.



#### **4.5.1 Dry Run Testing**

Prior to the start of the functional performance test, the Contractor shall conduct a complete and formal dry run of the entire functional performance test to verify that the System is ready to be tested by the Owner. The Contractor shall follow the approved test plan and procedures and record all variances found during the dry run testing. Written certification that the dry run has been successfully completed shall be provided to the Owner by the Contractor prior to the start of the Owner-witnessed functional performance test.

All variances that would preclude testing all of, or portions of, the formal factory testing shall be corrected by the Contractor prior to the start of Owner-witnessed functional performance tests. The Contractor shall provide the Owner with copies of all variances found during the dry run testing. The Owner shall have the right to review the variances with the Contractor and to determine which variances must be fixed prior to the start of the formal factory testing.

At the Owner's option, Owner representatives may witness and participate in all, or portions of, the dry run of the functional performance test.

#### **4.5.2 Functional Performance Test**

The functional performance testing shall completely test and verify that all features and functions of System hardware, software, and firmware have been properly designed and implemented. Owner representatives will participate in the functional performance test of the fully integrated System, conducted at the Contractor's facility prior to shipment. The following items, at a minimum, shall be included in the functional performance test:

- a. Inspection of all equipment for conformance to drawings, applicable standards, and satisfactory appearance
- b. Testing the proper functioning of all hardware by thoroughly exercising all devices, both individually and collectively
- c. Testing the proper functioning of all software and firmware features and operations, including test cases with normal and exception data
- d. Testing the proper functioning of all communication features and facilities, and all communications network control functions
- e. Testing of all revenue and non-revenue vehicle functions
- f. Testing of AVL functions using test vehicles and appropriate test map and database information for the routes that will be traversed
- g. Verification of all data transfers from other Owner systems, including the importation of GIS map and overlay data
- h. Testing of all user interface functions
- i. Simulation of hardware failures and failover of each System device that has a backup unit
- j. Simulation of data channel failure and recovery

- k. Verification that spare capacity and ultimate sizing requirements have been met, including expansion requirements
- l. Verification of the accuracy of the system performance monitoring software
- m. Verification that processor loading and system response time requirements have been met
- n. Verification of device and system recovery from AC power failures
- o. Verification of the accuracy of hardware and software documentation via random tests

If the Owner representatives believe the quantity and/or severity of the System variances warrant a restart of the functional performance test, the test shall be halted, remedial work shall be performed, and the complete test shall be rerun at a time agreed upon between the Contractor and the Owner.

#### **4.5.3 Unstructured Testing**

Periods of unstructured testing shall be performed during the course of the factory testing to allow the Owner representatives to verify the proper operation of the System under conditions not specifically included in the approved test procedures. Unstructured testing of specific functions, features, or operations may be conducted during the course of the structured testing where the unstructured testing does not impact the structured testing. Unstructured testing shall be allowed at the Owner's discretion, both at the end of a structured test segment and after the completion of the functional performance testing. At least one hour of each test day and eight hours at the end of testing shall be designated for unstructured test time during the factory tests. During unstructured tests, the Contractor's test representatives shall be present and available for consultation with the Owner representatives. All simulation software and hardware, and other test facilities used during the structured portions of the factory test shall be made available for the Owner's use during unstructured testing.

The factory tests shall be considered successfully complete only when all tests have been performed, all variances that the Owner determines must be fixed prior to system shipment have been resolved to the satisfaction of the Owner, all test records have been issued to the Owner, and the Owner acknowledges, in writing, successful completion of the factory testing and authorization to ship the System to the Owner.

#### **4.6 Field Performance Testing**

The field performance test shall be conducted after the System is installed at all the Owner sites; however, all System mobile equipment need not be installed prior to the start of this test. The purpose of this testing will be to ensure that the System, as installed in the field, works properly as a fully integrated and installed system. This testing shall encompass the full range of System functionality; however, it may concentrate on areas of the System operation that were simulated or only partially tested in the factory and areas where variances were found during factory testing. The Contractor shall provide on-site support during this testing to

assist in the testing, to help identify variances, and to correct any variances. Prior to the start of the field performance testing, all open, unresolved variances shall be reviewed by the Owner and the Contractor. The Owner shall determine which variances must be corrected prior to the start of the field performance test.

During this testing, all security aspects of the System, particularly LAN interfaces, shall be reviewed and thoroughly tested by the Owner security personnel prior to connecting the System to the Owner network. Testing shall include, but not be limited to, verifying that all the Owner required and approved security measures have been implemented and are functioning properly, that parameter settings are correct and consistent with the Owner's guidelines and practices, and that all appropriate measures have been taken to safeguard the Owner network. Any security problems or concerns shall be corrected, to the Owner's satisfaction before the System is connected to the Owner's network.

#### **4.7 Mini-Fleet Test**

Following the successful completion of the field performance test, a comprehensive test of the System shall be conducted with a small subset of the Owner's vehicle fleet. Mini-fleet test vehicles shall be equipped with all of the on-board vehicle equipment and software to be delivered and/or installed for the System. Three buses, two paratransit vehicles, and one non-revenue vehicle shall be used for this mini-fleet testing.

Mini-fleet test vehicles shall be operated in actual or simulated revenue service to fully test schedule and route adherence, AVL, data messaging, and all other System equipment and functions to the extent each vehicle is equipped, under actual service conditions. This test shall verify that all System components (fixed-end equipment, mobile equipment, software, and firmware) have been supplied, installed, and perform all functions in accordance with the specified requirements and the Contractor's design. Accuracy of the reported data, including APC data, and the accuracy of the System reports shall be verified during this mini-fleet test. The mini-fleet test buses may be operated on a selected subset of the routes provided these selected routes encompass the entire service area and will allow testing of all the operational and functional conditions expected to be encountered during the service day and throughout the entire service area.

The duration of the mini-fleet test will be dependent on the number of problems encountered and the need for additional testing; however, it is expected that the testing will take place over a period of at least two weeks. This testing will be repeated as necessary until the System is ready to support revenue service for the entire fleet.

The Contractor shall provide on-site support during this test to assist in the testing, to help identify variances, and to correct any variances. At the successful completion of the mini-fleet test and the correction of any resulting variances, the System shall be ready to support the gradual phase-over of the remainder of the Owner fleet into revenue service.

## **4.8 Phase-Over to Revenue Operations**

Following the successful completion of the mini-fleet testing, and the correction of the resulting variances, the balance of the Owner's fleet required by the Contract shall be phased-over to the System. The phase-over will be in accordance with the approved *Installation and Phase-over Plan* unless variances necessitate that the phase over be delayed or modified accordingly.

## **4.9 Availability Test**

Following the field performance test, the mini-fleet test, and the placing of the System and the Owner vehicle fleet into revenue service, a 30-day availability test shall be conducted to verify the System's ability to meet its availability requirements. All variances must be corrected and all hardware and software documentation must be received and approved by the Owner prior to the start of the availability test.

### **4.9.1 Availability Requirements**

The total System availability requirement shall be exhibited by the System in accordance with the availability criteria specified.

### **4.9.2 Test Responsibilities**

The Owner will be responsible for conducting the availability test. The test shall consist of normal System operations without special test equipment or procedures. Test records defined in the *Availability Test Plan* and procedures will be maintained by the Owner personnel.

The Contractor, as needed, shall provide System maintenance on an on-call basis, via either consultation or on-site assistance. When on-site maintenance support is needed, qualified Contractor personnel shall arrive at the site within 24 hours of notification.

### **4.9.3 Test Definitions**

The following definitions of downtime and hold time shall apply to the availability testing.

#### **4.9.3.1 Downtime**

Downtime occurs whenever the criteria for successful operation are not satisfied. Except where specifically stated otherwise, downtime shall be measured from the start of diagnostic procedures until full service is restored. In the event of multiple failures, the total elapsed time for repair of all problems shall be counted as downtime.

#### **4.9.3.2 Hold time**

During a test of this nature, certain contingencies may occur that are beyond the control of both the Contractor and the Owner. These contingencies may prevent successful operation of the System but, at the same time, are not valid for measuring availability. Such periods of unsuccessful operation may be declared

“hold time” by mutual agreement of the Owner and the Contractor. These periods will not be considered in availability statistics for acceptance purposes.

Specific instances of hold time contingencies are:

- a. **Scheduled Shutdown:** During scheduled shutdowns, or if an equipment failure occurs while its backup device is scheduled out-of-service, the resulting system outage shall be hold time, provided that service can be restored according to Contractor-specified procedures within thirty minutes.
- b. **Power Interruption and Environmental Excursion:** Loss of power or manual shutdown in the event of loss of environmental control shall be considered hold time. If the System is operated during periods of power or environmental conditions beyond those specified, any resultant downtime shall be considered hold time.
- c. **Service Response Time:** A maximum 24 hours of hold time will be allowed for the Contractor to respond to each call for maintenance support.
- d. **Other:** Hold time may be declared by mutual agreement of the Owner and the Contractor.

#### 4.9.4 Test Satisfaction

After 30 days of cumulative test time, test records shall be examined to determine conformance with availability criteria. If test objectives have not been met, the test shall continue until the specified availability is achieved, based on one of the following time periods:

- Total elapsed test time
- Consecutive 720-hour period of test time, exclusive of hold time.

After the satisfactory conclusion of the 30-day availability test, the availability of each System device shall be measured against the individual device availability criteria. If one or more System devices do not meet the criteria, then final Contract Acceptance of the System shall be delayed until the Owner and the Contractor mutually agree that corrective action has been completed for those devices. Corrective action shall include performing all necessary procedures to test and verify proper operation to the Owner’s satisfaction.

#### 4.10 Final Contract Acceptance

Final contract acceptance for the System shall occur, upon a determination by the Owner, that the Contractor has completed all work including, but not limited to, supplying and installing all equipment, software, and integrating and placing in service a complete and fully operational System after the successful completion of all tests, delivery of all equipment and other deliverables to the Owner, satisfactory completion of all contractual requirements, submittal by the Contractor of all drawings, test results, manuals, as-built and other documentation, completion of Contractor-provided training, correction of all variances, and the final clean-up of the System installation sites.

## 5 PROJECT MANAGEMENT

This Section describes the interface between the Owner's project personnel and the Contractor, and the schedule, quality assurance, and documentation requirements for the project.

### 5.1 *Project Management & Staffing*

The Owner's Project Manager will coordinate all Owner project activities.

The Contractor's Project Manager assigned to the System project shall have the authority to make commitments and decisions that are binding on the Contractor.

All communications between the Owner and the Contractor shall be coordinated through the Contractor's Project Manager and the Owner's Project Manager. Principal participants from the Contractor's staff shall have previous experience in a similar position on at least one other project similar in size and scope to the System project. The assignment and reassignment of key personnel to the System project by the Contractor shall be subject to the Owner's approval. Where technical skills are required to perform certain tasks, the Contractor shall ensure that the individuals performing the tasks hold the appropriate licenses and/or certifications.

Each reporting period the Contractor shall provide an updated project schedule and a complete progress report. Every other reporting period the Contractor shall attend a progress meeting at the Owner's site. The reporting period shall be monthly. All references to reporting period in this section shall refer to this monthly time frame.

The Contractor shall monitor and coordinate all Subcontractor work to ensure that it meets all Contract requirements.

### 5.2 *Project Schedule*

The time required to implement the System is of concern to the Owner. The Contractor shall submit a proposed schedule for the project with their proposal.

The Contractor shall produce and maintain a detailed project schedule based on the Contractor's system design and work plan. Proposers are encouraged to propose implementation approaches that reduce the implementation timeframes.

The System project implementation shall meet the following schedule requirements:

- **Project Schedule and Documentation List:** The final detailed project schedule and a complete list of training, hardware, software, and other documentation deliverables shall be provided within 20 calendar days after Contract Award.
- **PDR:** The Preliminary Design Review (PDR) shall be completed and the associated PDR documents approved within 60 calendar days after Contract Award.

- **FDR:** The Final Design Review (FDR) shall be completed and the associated FDR documents approved within 120 calendar days after Contract Award.
- **Factory Tests:** Factory tests shall be successfully completed and the System mobile equipment and fixed-end equipment shall be shipped and received by the Owner within 300 calendar days after Contract Award.
- **Mini-Fleet:** The mini-fleet test shall be successfully completed within 90 calendar days after System delivery.
- **Field Installation and Successful Implementation of the System and 50% of the Fleet:** Installation and successful implementation of the System including installation, check-out, and phase over to in-service operation of all fixed-end equipment and on-board vehicle equipment and functions on at least 50% of the revenue and non-revenue vehicles shall be successfully completed within 120 calendar days after System delivery.
- **Final Contract Acceptance:** Successful completion of the Availability Test and Final Contract Acceptance of the System by the Owner shall occur no later than 120 calendar days after System delivery.

The Contractor shall produce and maintain the System implementation project schedule. The System implementation schedule shall include, but not be limited to, the Contractor and Owner activities respectively, payment milestones, required dependencies with other Owner projects, project and technical meetings, the documentation schedule, training schedule, and percentage completions for all tasks.

The schedule shall be in a Gantt chart format with the project's critical path indicated.

The System project schedule shall be an accurate representation of the progress and planned activities for the project.

The Contractor shall maintain the project schedule using a commercially available project scheduling software product. The project scheduling software package used for the provided schedule will be, preferably, a current version of Microsoft Project.

### 5.2.1 Contractor Activities

The project schedule shall include all Contractor activities related to the System project, including the following:

- a. Contract Award
- b. Preliminary Design Review
- c. Final Design Review
- d. Hardware purchases, development, and integration
- e. Deliverables
- f. Documentation preparation and issue

- g. Owner documentation reviews
- h. Documentation revision and reissue following receipt of Owner comments
- i. Software design, coding, implementation, and subsystem integration
- j. System integration
- k. Pre-factory testing (including the dry run testing) and factory testing
- l. Shipments
- m. Training of Owner personnel
- n. Field installation of all fixed-end equipment
- o. Field testing phases
- p. Installation of the on-board vehicle equipment
- q. Final Contract Acceptance
- r. Start and expiration of Warranty

### **5.2.2 Owner Activities**

The project schedule shall include all Owner activities required for the Contractor to complete the System, including the following:

- a. Document review and approval
- b. Items required from the Owner
- c. Training performed by the Owner
- d. Site preparation work required of the Owner
- e. System testing
- f. Availability testing

### **5.2.3 Documentation Schedule**

Within 20 days after Contract Award, the Contractor shall provide a list of all System documentation to be provided during the project implementation and a plan for delivery of the documents for the Owner's review or approval.

The list shall be formatted to include the following:

- a. Document Title and description
- b. Application (where/how used)
- c. Proposed first submittal date
- d. Actual first submittal date
- e. Owner action taken and date
- f. Actual second submittal date
- g. Owner action taken and date



- h. Applicable specification section
- i. Remarks

The documentation review schedule shall be included in the project schedule.

A minimum of 20 working days shall be allotted for each Owner document review, unless otherwise specified. (Working days are defined as Monday through Friday, excluding Owner holidays.) The initial schedule shall assume that a minimum of two revisions of each document will be required prior to approval.

The Contractor shall update and submit the documentation list each reporting period. Any changes to the list other than the addition of actual submittal or action taken and action dates shall be called to the attention of the Owner.

#### **5.2.4 Training Schedule**

The Contractor shall prepare a recommended schedule for all proposed training courses as part of the Contract schedule.

Scheduling of training courses shall be coordinated with other activities in the project schedule.

### **5.3 Progress Reports**

The Contractor shall prepare a progress report each reporting period. The report shall be made available to the Owner at least one week prior to each progress review meeting.

The content and format of the progress report shall be subject to Owner approval but it is intended that the Contractor will use their standard reporting format, if it is suitable.

The progress report shall include an updated project schedule showing dates and percentage completions for each task. The progress report shall explain any deviations from the approved project schedule. The explanations shall include the anticipated impact of any delays and a plan for returning to the approved schedule. All delays shall be factored into the project schedule as soon as they are known to the Contractor's Project Manager.

All schedule changes that occurred since the last progress report shall be identified.

In addition to the above, the progress report shall include:

- a. An updated documentation schedule highlighting the documents to be transmitted for review during the next reporting period
- b. A summary of pending and upcoming Contractor and Owner activities during the next reporting period, along with required completion dates
- c. The status of unresolved Contract questions and change requests
- d. A description of current and anticipated project problem areas and steps to be taken to resolve each problem

## **5.4 Bi-Weekly Conference Calls**

The Contractor shall participate in bi-weekly conference calls with Owner representatives.

The purpose of these conference calls shall be to discuss any technical, schedule, action item, deliverable, coordination, and project management issues that need to be discussed in order to help keep the project on schedule.

These conference calls shall be scheduled for a mutually agreeable time, preferably at the same day and time every other week during the project. These conference calls will be conducted informally and both the Contractor and the Owner may propose topics to be discussed each week.

A conference call for any given week may be canceled or rescheduled if both the Contractor and the Owner agree to do so.

Brief notes of the topics discussed and action item revisions and additions resulting from these calls will be documented and distributed by the Owner.

## **5.5 Meetings**

The Contractor shall attend progress review meetings and conduct the technical project reviews described below.

### **5.5.1 Progress Review Meetings**

Progress review meetings shall be scheduled and attended by the Contractor, nominally every eight weeks, to review progress of the project and to discuss System technical issues.

Progress review meetings shall be used to discuss technical and contractual issues, discuss project coordination issues, and to review the progress report, the project schedule, written correspondence exchanged since the last meeting, open action items, and any other project matters.

The Contractor shall attend technical meetings as required to discuss technical aspects of the project. The Contractor is encouraged to combine technical discussion and progress review meetings in order to minimize the total number of project meetings.

At least 70% of all progress review meetings shall be held at the Owner's offices. The remaining 30% of progress review meetings shall be held at the Contractor's facility where the System development and testing work is being performed.

The Owner will record the minutes of each meeting, including action item revisions, and forward a copy to the Contractor for review.

### **5.5.2 Technical Project Reviews**

The Contractor shall conduct two major technical project review presentations in addition to the progress review meetings.

The first technical review, called the Preliminary Design Review (PDR), shall be conducted when the System design is 50% complete.

The second, called the Final Design Review (FDR), shall be conducted when the system design is 90% complete.

Submittals that are required for the design reviews shall be received by the Owner at least 15 working days before the design reviews. The PDR and FDR presentations and discussions shall be conducted at the Owner's facilities and are expected to be two to three days in length, but shall continue until all issues are resolved.

In order for the PDR and FDR reviews to be considered complete, the required design review documentation shall be submitted and approved by the Owner, the review meetings conducted, and all Contractor action items resulting from the design reviews that the Owner considers integral to the design review shall be completed and closed.

#### **5.5.2.1 Preliminary Design Review (PDR)**

For the PDR, the Contractor shall present the design approach for the System and for all major subsystems. Topics to be addressed during the PDR shall include the following:

- a. Total system functional description
- b. Software system overview and preliminary design
- c. Data radio system design
- d. Overall space layout and design
- e. Overall System hardware and software configuration
- f. System interfaces, communications interfaces
- g. Required customization and new development
- h. On-board vehicle equipment design, functions, and installation details

Samples of the Contractor-provided equipment to be installed on the revenue and non-revenue vehicles shall be presented for the Owner's inspection during the PDR.

The submittals that shall be provided for the PDR to support the design approach and the topics to be presented and discussed at the PDR are as follows:

- a. System Functional Description document
- b. Hardware configuration block diagram showing all Contractor-provided System equipment, including interfaces to other Owner systems and equipment
- c. Dispatch Center and Computer Equipment Room layout plans showing the proper dimensions and locations of the System equipment to be installed in the Dispatch Center and the Computer Equipment Room
- d. Data radio interface design documents, including all modifications to be made to existing equipment
- e. Scheduling System interface design documents

- f. Custom Hardware Design documents
- g. Sample System User's manual that describes the layout and content of all System displays, reports and the user actions required to perform each function available to System users
- h. System and site communications interface block diagrams
- i. On-board vehicle equipment block diagrams, typical vehicle equipment installation locations, functional descriptions, and vehicle power requirements
- j. Dispatch Center and Computer Equipment Room heat loads and electrical power requirements
- k. Vehicle Operator documentation that illustrates the vehicle operator equipment layout(s), screen displays, and provides detailed operating instructions and procedures for each function available to the Vehicle Operators using the Contractor-provided on-board vehicle equipment
- l. Electronic copy of all standard System reports

#### **5.5.2.2 Final Design Review (FDR)**

The FDR presentation shall include an update of all of the design activity to date. Approval of the FDR and associated documentation will allow the coding effort and other final designs to be formalized and completed.

Any unapproved design and implementation efforts conducted before the approval of the FDR will be at the Contractor's own risk.

In addition to the submission of previous documentation and equipment samples, updated to reflect the results of any design changes since the PDR review, the submittals shall include the following:

- a. Detailed System and site communications interface block diagrams and interconnect wiring details
- b. Detailed on-board vehicle equipment design and installation documentation, including block diagrams, interconnect wiring diagrams and details, equipment layouts, equipment installation locations and mounting details (for each type of vehicle), cable routing details, details of all proposed electrical and physical modifications to the vehicles and existing equipment, functional descriptions, and power requirements
- c. *System User's Manual* that has been customized for all of the specific System functions, features, user actions, displays, and reports to be supported and provided as part of the System.
- d. *System Vehicle Operator's Manual* that has been customized for all of the specific functions, features, user actions, displays, and messages to be supported and available to the Owner's vehicle operators
- e. As a prerequisite to completing the FDR, the proper form, fit, placement, and power requirements of the System equipment to be

installed onboard the Owner's vehicles shall be verified and approved by the Owner

## **5.6 Transmittals**

All textual documents shall be submitted in Microsoft Word™ format, or other Owner-approved format. Discussions and phone calls where important information is exchanged shall be documented in a transmittal.

The Contractor shall maintain a correspondence index and assign transmittal numbers consecutively for all Contractor documents.

The Owner will maintain a similar correspondence numbering scheme identifying documents and correspondence that it initiates.

## **5.7 E-Mail Communications**

The Contractor shall support electronic mail (E-mail) correspondence between project participants for routine and informal correspondence.

The use of E-mail is intended to provide for timely communication and document distribution among project personnel but it is not to be a substitute for formal communications and submittals required by the Contract. All such contractual communications, correspondence, and submittals shall be provided in hardcopy, as required by the Specification and Contract.

Any additional procedures or restrictions pertaining to the use of E-mail will be jointly developed by the Contractor and the Owner after Contract Award.

## **5.8 Use of Consultants**

No limitations shall be imposed on the Owner's use of consultants in any activity related to the project. The consultants, at the direction of the Owner Project Manager, shall be accorded the same access to facilities and participation in project activities as any member of the Owner's project team.

Involvement of consultants may include, but shall not be limited to, progress and technical meetings, conference calls, document reviews, installation reviews, and System testing. The Owner shall have the option of adding consultants to the distribution list to receive all correspondence initiated by the Contractor. The Owner shall be able to add consultants to the distribution list to receive all or selected system documents.

The consultants will be bound by the same confidentiality restrictions imposed on the Owner personnel.

## **5.9 Quality Assurance**

The definition, design, development, integration, testing, field installation, modification, and documentation activities of the System project shall be conducted in accordance with the Contractor's documented hardware and software quality assurance plan.

The Owner Project Manager or designated consultant shall be allowed to inspect the Contractor's hardware and software quality assurance standards, procedures,

activities, and records within one week of making a request for such an inspection.

Documents identified in the approved software quality assurance plan will be inspected to verify that the Contractor has performed the required quality assurance activities.

### **5.10 Document Review and Approval Rights**

To ensure that the System conforms to the specific provisions and general intent of this Specification, the Contractor shall submit documentation describing the System to the Owner for review and approval, as specified in this Specification.

The Owner will respond with written comments to the Contractor within 20 working days after receipt of the documents. Within 15 working days the Contractor shall resubmit to the Owner for approval all documents requiring correction along with written responses to each of the Owner's comments. The Owner will review the resubmitted documents and record its approval or submit additional comments to the Contractor within 15 working days after receipt of the document. No implementation schedule relief is to be implied for documents requiring further correction and resubmission to the Owner. All Contractor changes made to resubmitted documents shall be indicated by sidebars or shading/redlining of the modified text and drawings.

The Contractor shall stagger the release of documents over the time allocated in the project schedule for document review to assist the Owner in managing the review and turnaround of documents during any given time period. The number and length of documents shall be factored into the documentation release schedule.

The Contractor's proposed documentation review schedule shall be subject to the Owner's approval. The Owner shall have the right to require the Contractor to make any necessary documentation changes at no additional cost to the Owner, or the Contracting party, to achieve conformance with the Contract.

Any purchasing, manufacturing, or programming implementation initiated prior to written Owner approval of the relevant documents or drawings shall be performed at the Contractor's risk. Review and approval by the Owner shall not relieve the Contractor of its overall responsibilities to satisfy all functional requirements of this Specification.

#### **5.10.1 Standard Document Review**

Standard documentation of the Contractor's standard hardware, software, and firmware shall be furnished for the Owner's review, but approval shall be limited to the content of the document.

Specifically, the Owner reserves the right to determine that:

- a. All standard documentation for standard hardware, software, and firmware is in full conformance with this Specification

- b. The documentation accurately and completely describes all features, functions, operations, and options of the hardware, software, and firmware that pertain to the System
- c. That the documentation is the Contractor's standard, previously-delivered documentation

#### **5.10.2 Modified and Custom Documents Approval**

In cases where the Contractor's standard hardware, software, or firmware is modified or customized to meet the requirements of this Specification, the documentation shall require corresponding modification or customization and the Owner shall have unlimited approval rights to review and approve the portions of the document's content and format pertaining to the modified or custom hardware, software, and firmware.

The following conditions shall be satisfied for this approval:

- a. Hardware, software, and firmware shall be in full conformance with Contract requirements
- b. Changes and modifications shall be documented in a complete and clear manner in accordance with the Contractor's established documentation standards
- c. Features, equipment, and options pertaining to the Owner shall be clearly distinguished from those that do not pertain
- d. The Contractor shall follow its established quality assurance plan for design, implementation, and integration of the affected hardware, software, and firmware

#### **5.10.3 Functional Description and Test Document Approval**

The Owner shall retain full approval rights over all software functional description documentation and test documentation regardless of the standard, modified, or custom classification. The Owner shall have full approval rights over the user interface and user interface documentation pertaining to System functions.

## APPENDIX A -DEFINITIONS, ACRONYMS, AND ABBREVIATIONS

The following table provides the definitions of all terms, acronyms, and abbreviations required to properly interpret this Concept of Operations.

| Term                           | Definition   |
|--------------------------------|--|
| Acquirer                       | An organization that procures a system, software product, or software service from a supplier. (The acquirer could be a buyer, customer, owner, user, or purchaser.)                 |
| ADA                            | Americans with Disabilities Act  |
| ANSI                           | American National Standards Institute  |
| API                            | Application Programming Interface  |
| Architect                      | The person, team, or organization responsible for systems architecture.  |
| Architecting                   | The activities of defining, documenting, maintaining, improving, and certifying proper implementation of an architecture.  |
| Architectural Description (AD) | A collection of products to document a project architecture.   |
| Architecture                   | The fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution. |
| ATIS                           | Advanced Traveler Information System   |
| AVL                            | Automated Vehicle Location   |
| Block                          | Work performed by a revenue fixed-route vehicle between leaving and returning to a garage, depot, outstation, or other vehicle base.   |
| CAD                            | Computer-Aided Dispatch  |
| CFR                            | Code of Federal Regulations  |
| Contractor                     | The party awarded the Contract to supply the System and related services.  |
| COTS                           | Commercial, Off-the-Shelf  |
| CVO                            | Commercial Vehicle Operations  |
| Datum                          | A single data point  |
| DBMS                           | Database management system   |
| Deadhead                       | Non-revenue movement of a revenue vehicle between trips.   |



| Term           | Definition  |
|----------------|---|
| Dead reckoning | A method of estimating the position of a vehicle by applying to a previously determined position the course and distance traveled from the previous position.   |
| dRMS           | Distance Root Mean Square - The root-mean-square value of the distances from the true location point of the position fixes in a collection of measurements. As typically used in GPS positioning, 2 dRMS is the radius of a circle that contains at least 95 percent of all possible fixes that can be obtained with a system at any one place. |
| EIA            | Electronic Industries Alliance  |
| EMF            | Electro-Magnetic Field. A field of force, produced by electric charges and currents, which has both an electric and a magnetic component and contains electromagnetic energy.   |
| FCC            | Federal Communications Commission   |
| FHWA           | Federal Highway Administration  |
| Fleet          | A grouping of one or more vehicles  |
| FMS            | Freeway Management System   |
| FTA            | Federal Transit Administration  |
| FY             | Fiscal Year   |
| Gbps           | Gigabits per second. Giga is equivalent to one billion (1,000,000,000).   |
| GByte          | Giga-byte – 1 billion bytes   |
| GHz            | Gigahertz - One GHz represents 1 billion cycles per second.   |
| Headway        | Scheduled time between two trips at a time point or timetable listing sorted in headway sequence.   |
| HTML           | Hyper Text Markup Language  |
| HTTP           | Hyper Text Terminal Protocol  |
| HTTPS          | Secure Hyper Text Terminal Protocol   |
| Hz             | Hertz – cycles per second   |
| IEEE           | Institute of Electrical and Electronics Engineers   |
| IETF           | Internet Engineering Task Force   |
| IM             | Incident Management   |
| Incident       | An abnormal event that is documented by and Incident Report   |

| Term                    | Definition  |
|-------------------------|---|
| ISO                     | International Standards Organization - The International Standards Organizations. They do not create standards but (as with ANSI) provide a means of verifying that a proposed standard has met certain requirements for due process, consensus, and other criteria by those developing the standard. |
| ISP                     | Information Service Provider  |
| IT                      | Information Technology  |
| ITS                     | Intelligent Transportation System   |
| JPEG                    | Joint Photographic Expert Groups. Compression technique that causes some detail to be lost during compression.  |
| Kbps                    | Kilobits per second. Kilo is equivalent to one thousand (1,000).  |
| km                      | Kilometers  |
| LAN                     | Local Area Network  |
| Life cycle model        | A framework containing the processes, activities, and tasks involved in the development, operation, and maintenance of a software product, which spans the life of the system from the definition of its requirements to the termination of its use.  |
| LRMS                    | Location Referencing Message Specifications   |
| L RTP                   | Long Range Transportation Plan  |
| MAT                     | Metro Area Transit – Transit provider in Omaha, Nebraska  |
| Mbps                    | Megabits per second. Mega is equivalent to one million (1,000,000).   |
| MDT                     | Mobile Data Terminal  |
| MHz                     | Megahertz - One MHz represents one million cycles per second.   |
| MJPEG                   | Motion JPEG. A moving image which is made by storing each frame of a moving picture sequence in JPEG compression, then decompressing and displaying each frame at rapid speed to show the moving picture.   |
| MPEG                    | Moving Picture Experts Group. Family of digital video compression standards and file formats. There are three major standards: MPEG-1, MPEG-2 and MPEG-4.   |
| MPO                     | Metropolitan Planning Organization  |
| ms                      | Millisecond   |
| Multi-path interference | Interference caused by reflected GPS signals arriving at the receiver, typically as a result of nearby structures or other reflective surfaces. Signals traveling longer paths produce higher (erroneous) pseudo-range estimates and, consequently, positioning errors.                               |

| Term          | Definition   |
|---------------|--|
| NDOR          | Nebraska Department of Roads   |
| NEMA          | Nebraska Emergency Management Agency   |
| NPSPAC        | National Public Safety Planning Advisory Committee   |
| NSP           | Nebraska State Patrol  |
| NTCIP         | National Transportation Communication for ITS Protocol   |
| ODBC          | Open Database Connectivity (ODBC) is a standard or open application programming interface (API) for accessing a database.  |
| OEM           | Original Equipment Manufacturer  |
| OSF           | The Open Software Foundation is an international consortium that promotes the standardization of the UNIX operating system.  |
| Paddle        | A description of a full day's service for an operator, including route description, scheduled times, and comments.   |
| Pan           | To scroll to a different part of an image on screen.   |
| POTS          | Plain Old Telephone System   |
| Pull-out      | 1. A bus leaving its garage.<br>2. Scheduled time of a pull-out  |
| QWERTY        | Refers to the key scheme for the standard English language keyboard.   |
| RAM           | Random Access Memory   |
| RFI           | Radio Frequency Interference. Interference from high-frequency electromagnetic waves emanating from electronic devices.  |
| RMC           | Recommend Minimum Content  |
| Road Call     | Dispatching mechanics with or without a replacement bus to a bus on the road that has a mechanical failure or accident.  |
| Route         | A predefined path through the service area for which bus stops and a time schedule are defined.  |
| Rubberbanding | A feature of many graphics programs which shows how a line or other object will look before it is actually placed. An example is with the line command. A starting point is selected after which a line appears rubberbanded between the first point and the <u>cursor</u> . As soon as another point is selected the actual line is drawn and the rubberband moves to the next point. |
| RWIS          | Road Weather Information Systems   |
| SAE           | Society of Automotive Engineers  |

| Term                 | Definition  |
|----------------------|---|
| Schedule             | A list of planned arrival and/or departure times for each time point on a route, along with associated information, such as the route and time point names.   |
| SQL                  | Structured <u>Query</u> Language (SQL), pronounced “sequel”, is a language that provides an interface to <u>relational database</u> systems.  |
| System               | A collection of components organized to accomplish a specific function of set of functions.   |
| Third-party software | Software provided by the Contractor, but not developed by the Contractor  |
| TIA                  | Telecommunications Industry Association   |
| Time-point           | A location on a bus route assigned scheduled arrival times.   |
| TIP                  | Transportation Improvement Plan   |
| Transfer             | 1. A passenger getting off one transit vehicle and getting onto another.<br>2. The slip of paper denoting proof of cash or ticket payment.  |
| Trip                 | One-way movement of a revenue vehicle between two points.   |
| TTFF                 | Time To First Fix – The time from power up of the GPS unit until it has a location fix on 3 or more satellites.   |
| Turn-back            | To turn a late bus around before the end of a scheduled trip in order to get it back on schedule. Also called “Cut for Schedule”.   |
| UTC                  | Universal Time Coordinated, the international time standard, also known as Greenwich Meridian Time (GMT)  |
| VAC                  | Volts, Alternating Current  |
| VDC                  | Volts, Direct Current   |
| VHF                  | Very High Frequency   |
| View                 | A representation of a whole system from the perspective of a related set of concerns.   |
| Viewpoint            | A specification of the conventions for constructing and using a view. A pattern or template from which to develop individual views by establishing the purposes and audience for a view and the techniques for its creation and analysis. |
| VoIP                 | Voice over Internet Protocol or Voice over IP. Sending voice information in digital (packets) rather than in the traditional circuit-committed protocols of the public switched telephone network.  |
| WAN                  | Wide Area Network   |
| Wi-Fi                | Wireless fidelity. Used generically when referring to any type of 802.11 network.   |

| <b>Term</b> | <b>Definition</b>  |
|-------------|--|
| Wild Card   | A symbol that stands for one or more unspecified characters, used especially in searching text and in selecting multiple files or directories. |
| Wi-MAX      | Wireless Interoperability for Microwave Access. Used generically when referring to any type of 802.16 network.                                 |

## APPENDIX B - EXISTING STARTRAN FACILITIES AND EQUIPMENT

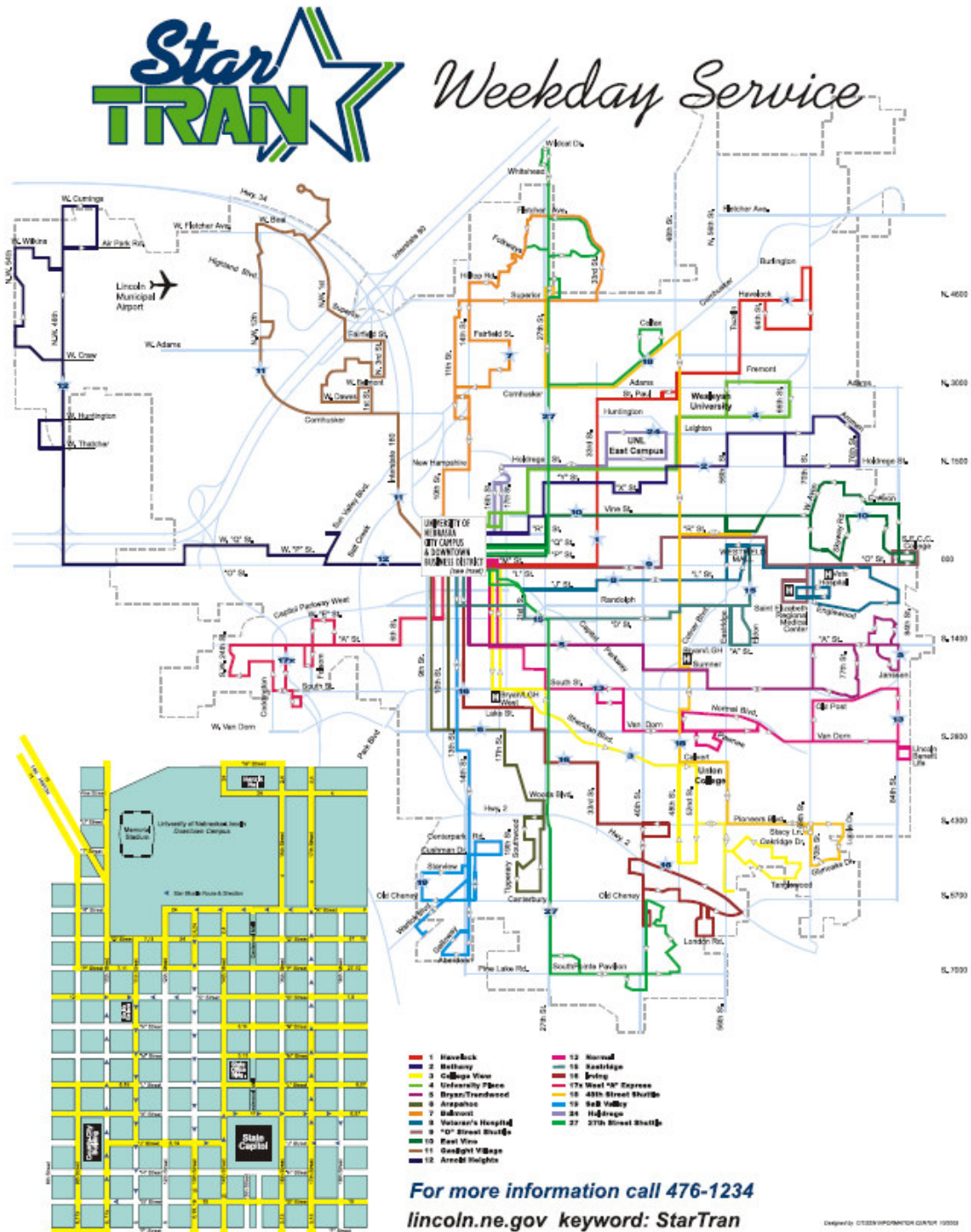


Figure 2 - StarTran Weekday Route Map

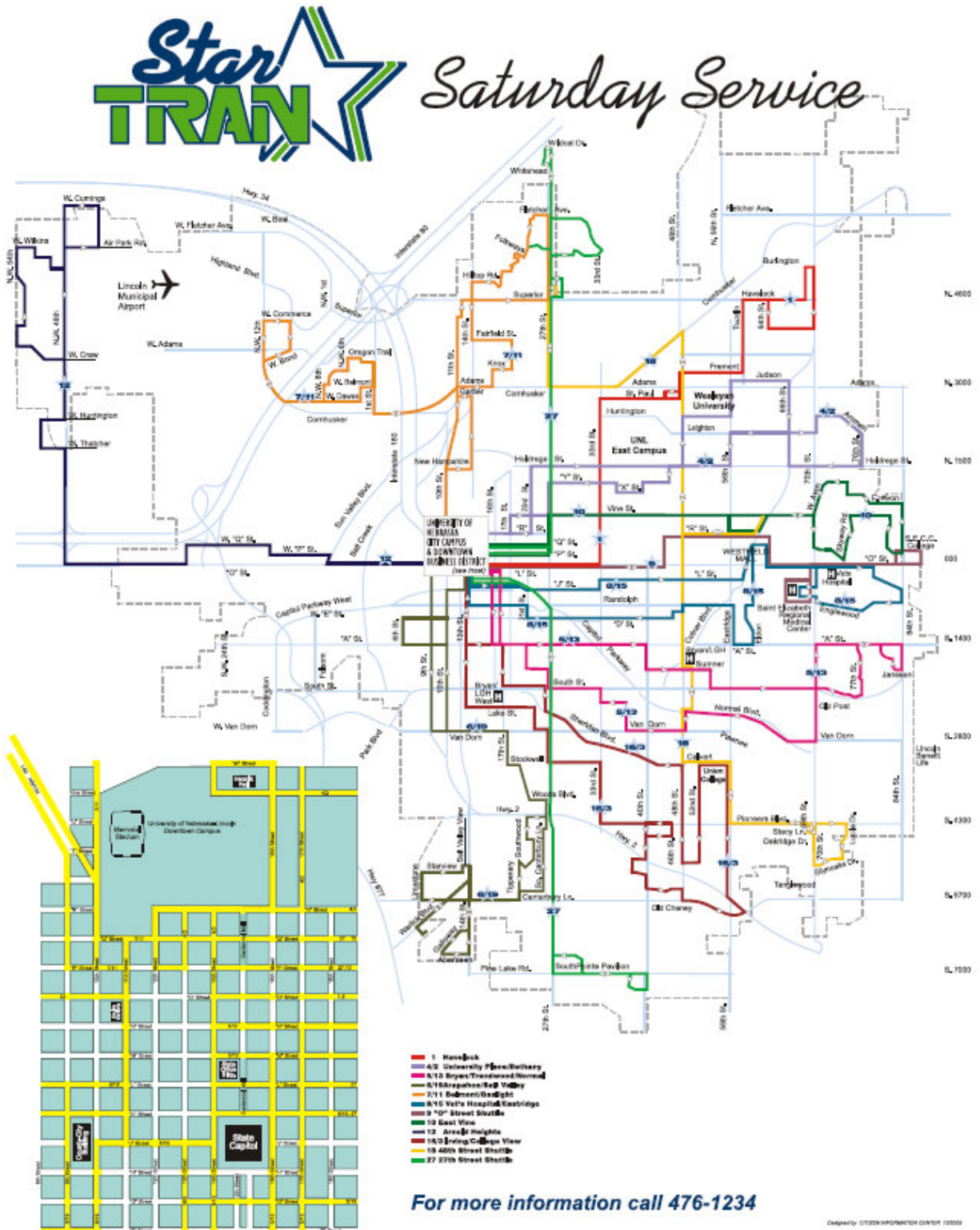


Figure 3 - StarTran Weekend Service Map

The following table shows the current number of vehicles and quantities required for System equipment.

**Table 4 - Existing Vehicle Equipment Requirements**

| Number of Vehicles | Type/ Year                 | Model    | Number of Doors With APC | Number of ADA Announcement Controllers | Number of ADA Internal Signs | GPS | Contact Interface | MDT |
|--------------------|----------------------------|----------|--------------------------|--|------------------------------|-----|-------------------|-----|
| 15                 | GILLIG/ 2006               | LOWFLOOR | 2                        | 1                                      | 1                            | Yes | Yes               | Yes |
| 15                 | GILLIG/ 1997               | PHANTOM  | 2                        | 1                                      | 1                            | Yes | Yes               | Yes |
| 20                 | GILLIG/ 2001               | LOWFLOOR | 2                        | 1                                      | 1                            | Yes | Yes               | Yes |
| 10                 | GILLIG/ 2004               | LOWFLOOR | 2                        | 1                                      | 1                            | Yes | Yes               | Yes |
| 9                  | GLAVAL/ 2003               |          | 1                        | 1                                      | 1                            | Yes | Yes               | Yes |
| 1                  | Car/ 1996                  |          |                          |  |                              | Yes |                   |     |
| 1                  | Supervisor/ SUV/ 2003      |          |                          |  |                              | Yes |                   | Yes |
| 1                  | Supervisor/ Mini-Van/ 2004 |          |                          |  |                              | Yes |                   | Yes |
| 1                  | Pick-up/ 1996              |          |                          |  |                              | Yes |                   |     |
| 1                  | Pick-up/ 1999              |          |                          |  |                              | Yes |                   |     |
| 1                  | Snowplow/ Pick-up/ 2001    |          |                          |  |                              | Yes | Yes               | Yes |
| 1                  | Snowplow/ 2006             |          |                          |  |                              | Yes | Yes               | Yes |



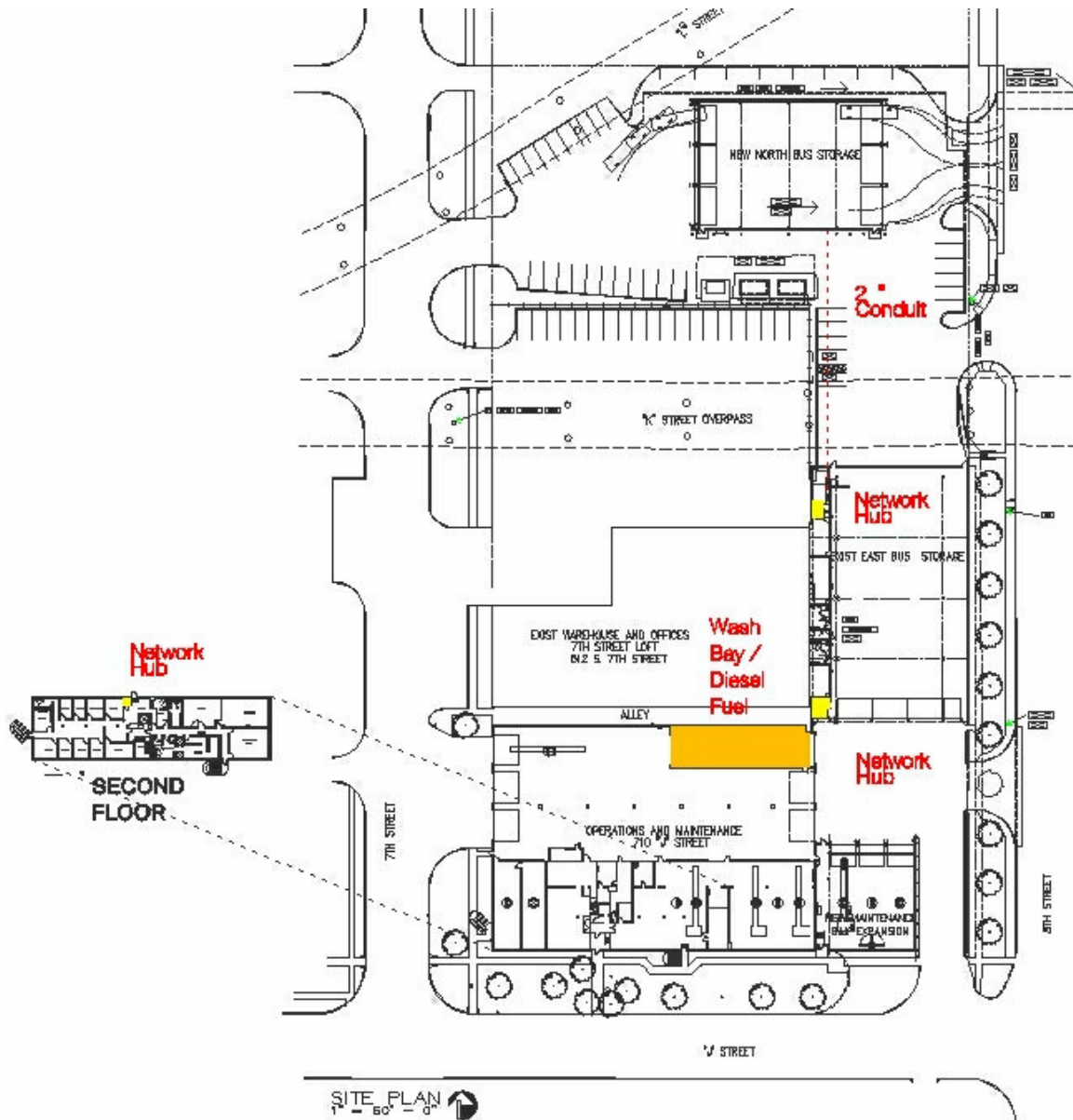


Table 5 - StarTran LAN at Base Location

The City of Lincoln owns and operates a significant inventory of both multi-mode and single mode fiber. There are 3 main facilities that may be a part of a proposed AVL solution. Information Services (Oracle Server Location), Engineering Services (location of any other servers) and The StarTran bus facility (Dispatchers & Workstations). The City Currently has fiber to each facility. We are currently running a 1 Gb Ethernet solution to each facility. The fiber will have a redundant path sometime in the Fall of 2006. All three facilities are within 2 miles of each other in the downtown area of Lincoln.



Figure 4 - StarTran Wide Area Network

Table 6 - StarTran Existing Printer

| StarTran Existing Printer Description                    |
|--|
| Printer is a Konica model #7130 using IP-422 PCL drivers |

**Table 7 - StarTran Existing Oracle Server Configuration**

| StarTran Existing Oracle Server Configuration  |
|--|
| <p>2 HP DL380 servers. Identical specs for each server:</p> <ul style="list-style-type: none"> <li>• 1 3.4 GHz Xeon processor</li> <li>• GB RAM</li> <li>• 2 72GB 15K mirrored drives</li> <li>• Windows 2003 SP1</li> </ul> <p>The two servers are clustered using MSCS in an active-passive configuration.</p> <p>One MSA 1000 external storage array with redundant controllers and switches.</p> <ul style="list-style-type: none"> <li>• 200 GB free disk space in an RAID 5 array</li> <li>• Connected to the network via Gigabit NIC.</li> </ul> <p>Oracle 9i Release 2 (9.2.0.6)</p> <p>Oracle Fail Safe for failover integration with MSCS.</p> |

**Table 8 - Server Environment**

|   |
|---|
| <p>With the exception of the Oracle Server at information services, all multiple user equipment (servers) shall be located in the server room at Engineering Services. The City will allow space for one entire rack for this application.</p> <p>The room is to be remodeled this summer and a floor plan will be provided later.</p> <p>The temperature control system is a Liebert 2 ton isolated system with plenty of spare capacity.</p> <p>The City will install whatever dedicated power circuits are deemed necessary for this application. The City will provide a UPS capable of supporting the AVL equipment for at least 45 minutes.</p> <p>Other than at Information Services, there is no backup power supply at any location.</p> |
|---|

## APPENDIX C - DESIGN REQUIREMENTS

**Table 9 - AVL Data Import/Export Protocol**

The NMEA-based protocol is used to transmit one vehicle location report per line using ASCII. Each text file contains one line of data for each vehicle in the fleet. The fleet name is used as the name for the text file (e.g. FLEET1.TXT)

The beginning of each report contains the unique identifier of the vehicle which generated the report, followed by the RMC sentence containing the location data.

Each report contains 14 comma separated fields as follows:

**Vehicle ID.** Unique identifier for vehicle, expressed as a freeform string comprised of any number of characters (except a comma).

**Sentence ID.** This is the NMEA sentence ID "\$GPRMC" which indicates the Recommended minimum specific GPS/Transit sentence format.

**Time.** UTC time for the vehicle position report in hours, minutes and seconds (and optionally, fractions of a second) using the format: "hhmmss.MMM". Acceptable times values can range from 00:00:00 (Midnight) to 23:59:59 (11:59:59PM). Example: 21:43:56 UTC is expressed as: 214356.

**Status.** Position status. Acceptable values: "A" = Data valid, "V" = Data invalid.

**Latitude.** Latitude of vehicle in degrees and minutes (expressed as a floating point value using the format "ddmm.mm"). Any number of decimal digits of precision can be accommodated. Acceptable values range from 0 to 90 degrees. Use "latitude reference" field to indicate + or -. Example: a latitude of 49 degrees, 16.45 minutes is expressed as: 4916.45.

**Latitude Reference.** Reference/Direction of latitude measurement from the equator, either north or south. Acceptable values are: "N" or "S".

**Longitude.** Longitude of vehicle in degrees and minutes (expressed as a floating point value using the format "dddmm.mm"). Any number of decimal digits of precision can be accommodated. Acceptable values range from 0 to 180 degrees. Use the "longitude reference" field to indicate + or -. Example: a longitude of 123 degrees, 11.22 minutes is expressed as: 12311.22.

**Longitude Reference.** Reference/Direction of longitude measurement from the Prime Meridian, either east or west. Acceptable values are: "E" or "W".

**Speed.** Speed of vehicle over ground in knots (expressed as a floating point value).

**Heading.** Heading/track of vehicle made good, in degrees true (expressed as a floating point value). 0=North, 90=East, 180=South, 270=West.

**Date.** UTC Date of vehicle position report using the format: "ddmmyy".

**Magnetic Variation.** Magnetic variation in degrees (expressed as a floating

point value).

**Magnetic Reference.** Reference/Direction of magnetic variation. Acceptable values are "E" or "W".

**Checksum.** (The checksum is obtained by XORing all characters bytes in ASCII code between a "G" following "\$" at the beginning of NMEA data and the character byte just before "\*" at the end of a packet, and the resulting 1 byte is expressed in hexadecimal two characters in the ASCII code.

The formal grammar for each AVL report in EBNF (Extended Backus Naur Form) is:

```

<avl_report>
where:
<avl_report> ::= <avl_data><newline>
<avl_data> ::= <vehicle_id>,"<nmea_sentence>
<date_time> ::= <year>-<month>-<day> <hour>:<minute>:<second>
<vehicle_id> ::= <string>
<nmea_sentence> ::=
<sentence_id>,"<time>","<status>","<lat>","<lat_ref>","<lon>","<lon_ref>","<speed>
d>","<heading>","<date>","<mag_var>","<mag_ref>"] [<checksum>]
<sentence_id> ::= "$GPRMC"
<time> ::= <hour><minute><second>[.<digit>+]+
<pos_stat> ::= "A" | "V"
<lat> ::= <float>
<lat_ref> ::= "N" | "S"
<lon> ::= <float>
<lon_ref> ::= "E" | "W"
<speed> ::= <float>
<heading> ::= <float>
<date> ::= <day><month><year>
<mag_var> ::= <float>
<mag_ref> ::= "E" | "W"
<checksum> ::= "*"<digit><digit>
<year> ::= <digit><digit> (e.g. 03, 04, etc)
<month> ::= <digit><digit> (e.g. Jan=01, Feb=02, ... Dec=12)
<day> ::= <digit><digit> (e.g. 1st=01, 2nd=02, ... 31st=31)
<hour> ::= <digit><digit> (e.g. midnight=00:00:00, 11PM=23:00:00, etc)
<minute> ::= <digit><digit>
<second> ::= <digit><digit>
<digit> ::= "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"
<float> ::= {<digit>+}.{<digit>+}
<integer> ::= {<digit>+}
<letter> ::= "a" | ... | "z" | "A" | ... | "Z"
<character> ::= <number> | <letter>
<string> ::= {<character>+}
<newline> ::= 0x0D0A | 0x0A

```

## Examples

- In this example, bus 1421 reported on January 21, 2004 at 20:32:07 UTC. It reported a valid location at 39 degrees, 59.9120 minutes N latitude and 105 degrees 15.1637 minutes W longitude. It was traveling at 0.1 knots and heading 181.6 degrees of true north. Magnetic variation data was not present and the checksum was 0x23.

1421,\$GPRMC,203207.00,A,3959.9120,N,10515.1637,W,0.1,181.6,210104,,\*23

- In this example, bus Trolley12 reported on June 17, 2003 at 17:22:57 UTC. It reported a valid location at 37 degrees 47.469867 minutes N latitude and 122 degrees 24.053351 minutes W longitude. It was traveling at 6.613 knots and heading 125.64 degrees of true north. Magnetic variation data was not present and the checksum was 0x13.

Trolley12,\$GPRMC,172257.00,A,3747.469867,N,12224.053351,W,006.613,125.64,170603,,\*13



**Table 10 - ATIS TriMet Schedule Data Interface Specification**

## **Introduction**

A sample of the TriMet schedule data format is available for download at:  
<http://www.trimet.org/dev/schedule/>

In this directory you will find numbered files, gzipped and tarred. They are numbered according to the date the schedule takes effect.

<4 digit year><2 digit month><2 digit day>.tar.gz

The contents of this file are also extracted into the directory as well.

Schedules generally become active on Sundays and are posted no later than Saturday at 6:00pm. They may be posted on Friday.

The contents of these files are described below.

### **General terminology:**

- **Route:** Collection of ordered stops advertised to the public as a common name (17 Holgate). Publicly these are known as “Lines”.
- **Direction:** One of 2 general directions of travel on a route (Inbound - 17 Holgate to Portland, Outbound - 17 Holgate to 136th & Powell).
- **Pattern:** A unique travel path through the street network to visit selected stops for one Route in one Direction.
- **Trip:** One iteration of a vehicle traveling along given pattern (i.e. 17 from downtown to 136th & Powell. 136th & Powell to downtown would be the next trip).

## **Data Files**

The symbol '\*' designates primary key columns in each of the following data files.

### **location.csv**

- **Description:** Physical location of all stops in the system. One location record may be referenced by many routes.
- **Data Fields:**
  - \*location\_id number (1-99999) unique identifier for a stop location (potentially shared by multiple routes).
  - public\_location\_description varchar2(50) – description of the stop
  - zone char(2) (00/01/02/03) Fare zone
  - longitude number
  - latitude number
  - x\_coordinate number – State plane NAD 83 Oregon North coordinate
  - y\_coordinate number - State plane NAD 83 Oregon North coordinate

### **route.csv**

- Description: Route description information.
- Data Fields:
  - \*route\_number number (1-999)
  - public\_route\_description varchar2(40)
  - route\_type char(1) (B=Bus, R=Rail)

### **direction.csv**

- Description: Describes up to 2 directions for each route.
- Data Fields:
  - \*route\_number number (1-999)
  - \*direction number (0-1)
  - public\_direction\_description varchar2(50)

### **stop\_distance.csv**

- Description: All stops for a given pattern in order by distance.
- Data Fields:
  - \*route\_number number (1-999)
  - \*direction number (0-1)
  - \*pattern\_id number (1-9999) Geographic pattern identifier for given route and direction.
  - \*stop\_distance number Distance in feet from the beginning of the pattern.
  - location\_id number (1-99999) Unique identifier for a stop location (potentially shared by multiple routes).

### **shape\_distance.csv**

- Description: Shape points necessary to trace pattern through the street network.
- Data Fields:
  - \*route\_number number (1-999)
  - \*direction number (0-1)
  - \*pattern\_id number (1-9999) Geographic pattern identifier for given route and direction.
  - \*shape\_point\_distance number Distance in feet from the beginning of the pattern.
  - longitude
  - latitude

### **schedule\_period.csv**

- Description: Single record definition of time period the schedule files are valid for.
- Data Fields:
  - \*service\_begin\_date date yyyyymmdd

- service\_end\_date date yyyymmdd

### **calendar.csv**

- Description: Defines all service\_keys in effect for each date.
- Data Fields:
  - \*calendar\_date date yyyymmdd
  - \*service\_key char(1)

### **trip.csv**

- Data Fields:
  - \*route\_number number (1-999)
  - \*direction number (0/1)
  - \*service\_key char(1)
  - \*trip\_number number (1-9999)
  - pattern\_id number (1-9999) Geographic pattern identifier for given route and direction.
  - train number (1-9999) The collection of trips that make up a unit of work assigned to a vehicle from pull out to pull in.
  - trip\_origin\_description varchar2 (36) A representation of the overhead signage that would appear on the vehicle at the beginning of the trip.
  - trip\_destination\_description varchar2 (36) A representation of the overhead signage that would appear on the vehicle at the end of the trip.

### **stop\_time.csv**

- Description: Scheduled stop time for all stops by trip.
- Data Fields:
  - \*route\_number number (1-999)
  - \*direction number (0-1)
  - \*service\_key char(1)
  - \*trip\_number number (1-9999)
  - \*stop\_time number (1-97200) Seconds after midnight of service date.
  - stop\_distance number Distance in feet from the beginning of the pattern for the current trip.
  - location\_id number (1-99999) Unique identifier for a stop location (potentially shared by multiple routes).



**Table 11 - Documentation Deliverables - Quantities Required**

| Documentation                            | Draft Submittal | Final Submittal |
|--|-----------------|-----------------|
| System Functional Description            | 3               | 5               |
| Hardware Documentation                   |                 |                 |
| Hardware Inventory                       | 3               | 3               |
| Server Block Diagram                     | 3               | 3               |
| Site preparation Manuals                 | 3               | 5               |
| Site floor plans                         | 3               | 3               |
| Rack layouts                             | 3               | 5               |
| Server wiring and cabling diagrams       | 3               | 5               |
| Hardware Reference Manuals               | 0               | 1               |
| Vehicle Drawings (each vehicle type)     | 3               | 20              |
| Maintenance Manuals                      | 3               | 20              |
| Software Documentation                   |                 |                 |
| OEM manuals for COTS software            | 0               | 1               |
| Interface Definition Documentation       | 3               | 5               |
| Firmware Documentation                   | 3               | 5               |
| Database Documentation                   | 3               | 5               |
| System Dispatcher/Supervisor User Manual | 3               | 20              |
| Vehicle Operator User Manual             | 3               | 100             |
| System Administrator User Manual         | 3               | 5               |

**Table 12 - Sample StarTran Trip Report**

| PAGE                   | 1     | StarTran |              |              |                |                       |                                  |                     |               |             |                         |
|------------------------|-------|----------|--------------|--------------|----------------|-----------------------|----------------------------------|---------------------|---------------|-------------|-------------------------|
| *****                  |       |          |              |              |                |                       |                                  |                     |               |             | DIR=1                   |
| #1 HAVELOCK            |       |          |              |              |                |                       |                                  |                     |               |             |                         |
| Weekday                |       |          |              |              |                |                       |                                  |                     |               |             |                         |
| TRIP REPORT            |       |          |              |              |                |                       |                                  |                     |               |             |                         |
| DECEMBER 2005          |       |          |              |              |                |                       |                                  |                     |               |             |                         |
| *****                  |       |          |              |              |                |                       |                                  |                     |               |             |                         |
| TRIP<br>DEPART<br>TIME | BLOCK | RIDERS   | TRIP<br>TIME | VEL<br>(MPH) | LOAD<br>FACTOR | 120%<br>LOAD<br>DURTN | DOOR<br>CYCLES<br>DURING<br>TRIP | PASS<br>PER<br>HOUR | PASS<br>MILES | MAX<br>LOAD | NUMBER<br>OF<br>SAMPLES |
| 05:15                  | 101   | 5        | 27.6         | 24.5         | .046           | .0                    | 9                                | 11.1                | 21.6          | 4           | 10                      |
| 06:10                  | 101   | 15       | 28.3         | 20.9         | .073           | .0                    | 14                               | 32.9                | 30.7          | 6           | 10                      |
| 07:10                  | 101   | 19       | 32.4         | 17.3         | .090           | .0                    | 21                               | 36.4                | 33.5          | 7           | 10                      |
| 08:15                  | 101   | 20       | 32.6         | 17.1         | .100           | .0                    | 19                               | 36.7                | 37.1          | 11          | 10                      |
| 09:25                  | 101   | 16       | 40.8         | 13.6         | .087           | .0                    | 18                               | 24.1                | 25.6          | 7           | 10                      |
| 10:45                  | 101   | 15       | 34.3         | 16.3         | .063           | .0                    | 19                               | 26.7                | 24.6          | 7           | 10                      |
| 11:55                  | 101   | 16       | 35.4         | 15.5         | .098           | .0                    | 24                               | 28.2                | 36.2          | 8           | 10                      |
| 13:05                  | 101   | 7        | 6.9          | 10.2         | .122           | .0                    | 4                                | 80.3                | 26.0          | 1           | 10                      |
| 14:15                  | 101   | 4        | 14.2         | 14.5         | .056           | .0                    | 10                               | 32.9                | 9.6           | 3           | 12                      |
| 14:50                  | 104   | 11       | 37.8         | 14.7         | .080           | .0                    | 20                               | 17.5                | 37.8          | 6           | 8                       |
| 15:25                  | 101   | 13       | 25.4         | 12.8         | .077           | .0                    | 20                               | 36.0                | 15.2          | 7           | 12                      |

**Figure 5 - Service Report**

| WEEKDAY EFFECTIVE 08/18/05 |                         |         |        |           |           |            |         |         |          |         |        |
|----------------------------|-------------------------|---------|--------|-----------|-----------|------------|---------|---------|----------|---------|--------|
|                            |                         | REVENUE |        |           |           | DAILY      |         | DAILY   | TOTAL    |         |        |
| ROUTE                      |                         | MILES/  | #      | EXTENSION | EXTENSION | NONSERVICE | REVENUE | DAILY   | PLATFORM | PRETIME | TOTAL  |
| #                          | NAME                    | TRIP    | ROUTE  | MILES     | TRIPS     | MILES      | MILES   | MILES   | HRS/MIN  | MINUTES | TIME   |
| 1                          | HAVELOCK                | 16.13   | 19     |           |           | 8.08       | 306.47  | 314.55  | 21.75    | 0.68    | 22.43  |
| 2                          | BETHANY                 | 14.12   | 19     |           |           | 9.68       | 268.28  | 277.96  | 20.18    | 0.68    | 20.86  |
| 3                          | COLLEGE VIEW            | 12.73   | 21     | 2.40      | 4         | 9.30       | 276.93  | 286.23  | 21.33    | 0.82    | 22.15  |
| 4                          | UNIV PLACE              | 12.88   | 26     |           |           | 16.94      | 334.88  | 351.82  | 25.91    | 1.18    | 27.09  |
| 5                          | BRYAN/TRENDWOOD         | 15.58   | 19     | 0.80      | 2         | 7.44       | 297.62  | 305.06  | 21.09    | 0.68    | 21.77  |
| 6                          | ARAPAHOE                | 12.72   | 21     |           |           | 3.50       | 267.12  | 270.62  | 21.41    | 0.82    | 22.23  |
| 7                          | BELMONT                 | 15.30   | 15     |           |           | 5.20       | 229.50  | 234.70  | 16.50    | 0.25    | 16.75  |
| 8                          | VET'S HOSPITAL          | 13.51   | 12     |           |           | 6.00       | 162.12  | 168.12  | 14.91    | 0.68    | 15.59  |
|                            | Boosters - Lux C        | 4.81    | 2      |           |           | 13.32      | 9.62    | 22.94   | 11.82    | 0.50    | 12.32  |
| 9                          | "O" STREET SHUTTLE      | 17.11   | 11     |           |           | 8.08       | 188.21  | 196.29  | 13.41    | 0.68    | 14.09  |
|                            | Boosters - Lux A & B    | 4.81    | 4      |           |           | 26.64      | 19.24   | 45.88   | 4.67     | 0.68    | 5.35   |
| 10                         | EAST VINE SECC          |         |        | 2.31      | 9         | 12.10      | 20.79   | 32.89   | 20.82    | 0.82    | 21.64  |
|                            | Westfield               | 13.52   | 19     | 0.95      | 4         |            | 281.47  | 281.47  |          |         |        |
|                            | Boosters - Culler       | 9.02    | 1      |           |           | 4.68       | 9.02    | 13.70   | 0.75     | 0.18    | 0.93   |
|                            | Add'l Boosters - Culler | 3.22    | 3      |           |           | 15.22      | 9.66    | 24.88   | 3.50     | 0.50    | 4.00   |
| 11                         | GASLIGHT VILLAGE        | 16.90   | 9      |           |           | 1.92       | 152.10  | 154.02  | 9.33     | 0.33    | 9.66   |
| 12                         | ARNOLD HEIGHTS          | 17.72   | 14     | 3.38      | 8         | 2.88       | 277.22  | 280.10  | 14.50    | 0.50    | 15.00  |
|                            | Carol W./C. Center      |         |        | 0.70      | 3         |            | 2.10    | 2.10    |          |         |        |
|                            | Booster - N. Star       | 28.20   | 5      |           |           | 24.00      | 141.00  | 165.00  | 4.50     | 0.33    | 4.83   |
| 13                         | NORMAL                  | 16.80   | 18     | 0.50      | 2         | 9.30       | 315.90  | 325.20  | 20.32    | 0.82    | 21.14  |
|                            | Lincoln Benefit Life    |         |        | 2.50      | 5         |            | 12.50   |         |          |         |        |
| 15                         | EASTRIDGE REG           | 11.92   | 11     |           |           | 5.10       | 131.12  | 136.22  | 19.58    | 0.82    | 20.40  |
|                            | Westfield               | 13.69   | 7      |           |           |            | 95.83   | 95.83   |          |         |        |
| 16                         | IRVING SCHOOL           | 16.71   | 19     | 1.40      | 2         | 2.55       | 320.29  | 322.84  | 21.41    | 0.82    | 22.23  |
| 17                         | WEST "A"                | 10.30   | 5      |           |           | 1.50       | 51.50   | 53.00   | 4.50     | 0.50    | 5.00   |
| 18                         | 48th St. Shuttle        | 30.70   | 7.5    |           |           | 18.00      | 230.25  | 248.25  | 13.58    | 0.33    | 13.91  |
|                            | Booster - Lux D         | 9.50    | 2      |           |           | 12.00      | 19.00   | 31.00   | 2.67     | 0.5     | 3.17   |
| 19                         | SALT VALLEY             | 14.92   | 8      |           |           | 1.40       | 119.36  | 120.76  | 8.18     | 0.33    | 8.51   |
|                            | Boosters - S.West       | 13.06   | 1      |           |           | 3.60       | 13.06   | 16.66   | 1.33     | 0.17    | 1.50   |
| 24                         | HOLDREGE                | 7.70    | 35     |           |           | 16.94      | 269.50  | 286.44  | 27.91    | 1.18    | 29.09  |
| 27                         | 27th STREET SHTL North  | 15.30   | 12     | 2.90      | 2         | 4.95       | 189.40  | 194.35  | 12.18    | 0.33    | 12.51  |
|                            | South                   | 16.10   | 12     | 2.30      | 2         | 8.25       | 197.80  | 206.05  | 12.68    | 0.50    | 13.18  |
|                            | Boosters - Scott        | 6.16    | 2      |           |           | 4.95       | 12.32   | 17.27   | 3.00     | 0.50    | 3.50   |
|                            | Add'l Boosters - Scott  | 6.90    | 2      |           |           | 3.30       | 13.80   | 17.10   | 2.00     | 0.33    | 2.33   |
| 28                         | STAR SHUTTLE            | 3.59    | 37.5   |           |           | 2.80       | 134.63  | 137.43  | 16.16    | 0.68    | 16.84  |
| TOTAL FIXED ROUTES         |                         | 421.63  | 399.00 | 20.14     | 43.00     | 269.62     | 5379.61 | 5636.73 | 411.88   | 18.12   | 430.00 |
| HANDIVAN                   |                         |         |        |           |           |            |         |         | 77.25    | 2.50    | 79.75  |
| SYSTEM TOTAL               |                         | 421.63  | 399.00 | 20.14     | 43.00     | 269.62     | 5379.61 | 5636.73 | 489.13   | 20.62   | 509.75 |
| FIXED ROUTE                |                         | 328.25  | 342.00 | 20.14     | 43.00     | 144.97     | 4863.39 | 4995.86 | 349.73   | 13.25   | 362.98 |

**StarTran AVL System  
Procurement Specification**

| WEEKDAY EFFECTIVE 08/18/05 |              |         |       |           |           |            |         |        |          |         |       |
|----------------------------|--------------|---------|-------|-----------|-----------|------------|---------|--------|----------|---------|-------|
|                            |              | REVENUE |       |           |           |            | DAILY   | DAILY  | TOTAL    |         |       |
| ROUTE                      |              | MILES/  | #     | EXTENSION | EXTENSION | NONSERVICE | REVENUE | DAILY  | PLATFORM | PRETIME | TOTAL |
| #                          | NAME         | TRIP    | ROUTE | MILES     | TRIPS     | MILES      | MILES   | MILES  | HRS/MIN  | MINUTES | TIME  |
|                            | UNL ROUTE    | 7.70    | 35    | 0         | 0         | 16.94      | 269.5   | 286.44 | 27.91    | 1.18    | 29.09 |
|                            | LPS BOOSTERS | 85.68   | 22.00 | 0.00      | 0.00      | 107.71     | 246.72  | 354.43 | 34.24    | 3.69    | 37.93 |

SATURDAY EFFECTIVE 08/18/05

|                    |                        | REVENUE |        |           |           |            | DAILY    | DAILY    | TOTAL    |         |        |
|--------------------|------------------------|---------|--------|-----------|-----------|------------|----------|----------|----------|---------|--------|
| ROUTE              |                        | MILES/  | #      | EXTENSION | EXTENSION | NONSERVICE | REVENUE  | DAILY    | PLATFORM | PRETIME | TOTAL  |
| #                  | NAME                   | TRIP    | ROUTE  | MILES     | TRIPS     | MILES      | MILES    | MILES    | HRS/MIN  | MINUTES | TIME   |
| 1                  | HAVELOCK               | 16.13   | 10     |           |           | 4.04       | 161.30   | 165.34   | 12.75    | 0.33    | 13.08  |
| 4                  | UNI/BETHANY            | 15.70   | 10     |           |           | 4.84       | 157.00   | 161.84   | 12.75    | 0.33    | 13.08  |
| 5                  | BRYAN/NORMAL           | 16.80   | 10     |           |           | 3.72       | 168.00   | 171.72   | 12.75    | 0.33    | 13.08  |
| 6                  | ARAPAHOE/S.VALLEY      | 12.72   | 11     |           |           | 1.40       | 139.92   | 141.32   | 13.33    | 0.33    | 13.66  |
| 7                  | BELMONT/               | 19.20   | 6      |           |           | 2.60       | 115.20   | 117.80   | 12.75    | 0.33    | 13.08  |
|                    | GASLIGHT               | 19.60   | 4      |           |           |            | 78.40    | 78.40    |          | 0.33    |        |
| 8                  | VET'S/EASTRIDGE        | 17.09   | 10     |           |           | 3.00       | 170.90   | 173.90   | 12.92    | 0.33    | 13.25  |
| 9                  | "O" STREET SHUTTLE     | 15.24   | 10     |           |           | 6.06       | 152.40   | 158.46   | 12.17    | 0.50    | 12.67  |
| 10                 | EAST VINE              | 13.05   | 10     | 0.95      | 10        | 7.26       | 140.00   | 147.26   | 12.75    | 0.50    | 13.25  |
| 12                 | ARNOLD HEIGHTS         | 13.41   | 9      |           |           | 1.92       | 120.69   | 122.61   | 11.58    | 0.33    | 11.91  |
| 16                 | IRVING/COL VIEW        | 18.40   | 10     |           |           | 3.06       | 184.00   | 187.06   | 12.75    | 0.50    | 13.25  |
| 18                 | 48th St Shuttle        | 27.30   | 7.5    |           |           | 18.00      | 204.75   | 222.75   | 13.05    | 0.33    | 13.38  |
| 27                 | 27th STREET SHTL North | 15.30   | 12     |           |           | 6.60       | 183.60   | 190.20   | 12.08    | 0.33    | 12.41  |
|                    | South                  | 16.10   | 12     |           |           | 6.60       | 193.20   | 199.80   | 12.08    | 0.33    | 12.41  |
| TOTAL FIXED ROUTES |                        | 236.04  | 131.50 | 0.95      | 10.00     | 69.10      | 2,169.36 | 2,238.46 | 163.71   | 4.11    | 167.82 |
| HANDIVAN           |                        |         |        |           |           |            |          |          | 15.75    | 0.34    | 16.09  |
| SYSTEM TOTAL       |                        | 236.04  | 131.50 | 0.95      | 10.00     | 69.10      | 2,169.36 | 2,238.46 | 179.46   | 4.45    | 183.91 |

BIG RED EXPRESS

HOLMES LAKE 11.95 MILES/TRIP

SECC 11.66 MILES/TRIP

DEPT OF ROADS 7.70 MILES/TRIP

GATEWAY 8.20 MILES/TRIP

SOUTH POINTE 15.65 MILES/TRIP

TOYS R US 9.73 MILES/TRIP

HOME DEPOT 5.80 MILES/TRIP

## **APPENDIX D -SAMPLE CONTRACT**

CONTRACT DOCUMENTS

CITY OF LINCOLN

NEBRASKA

## CONTRACT AGREEMENT

### CITY OF LINCOLN, NEBRASKA

THIS CONTRACT, made and entered into this \_\_\_\_\_ day of \_\_\_\_\_, 2006, by and between \_\_\_\_\_ hereinafter called contractor, and the City of Lincoln, Nebraska, a municipal corporation, hereinafter called the City.

WITNESS, that:

WHEREAS, the City has caused to be prepared, in accordance with law, Specifications, Plans, and other Contract Documents for the Work herein described, and has approved and adopted said documents and has caused to be published an advertisement for and in connection with said Work, to-wit:

and,

WHEREAS, the Contractor, in response to such advertisement, has submitted to the City, in the manner and at the time specified, a sealed Proposal in accordance with the terms of said advertisement; and,

WHEREAS, the City, in the manner prescribed by law has publicly opened, read aloud, examined, and canvassed the Proposals submitted in response to such advertisement, and as a result of such canvass has determined and declared the Contractor to be the lowest responsible proposer for the said Work for the sum or sums named in the Contractor's Proposal, a copy thereof being attached to and made a part of this Contract;

**EQUAL EMPLOYMENT OPPORTUNITY:** In connection with the carrying out of this project, the contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, ancestry, disability, age or marital status. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, national origin, ancestry, disability, age or marital status. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other compensation; and selection for training, including apprenticeship.

NOW, THEREFORE, in consideration of the sums to be paid to the Contractor and the agreements herein contained, the Contractor and the City have agreed and hereby agree as follows:

The Contractor agrees to (a) furnish all tools, equipment, supplies, superintendence, transportation, and other construction accessories, services, and facilities; (b) furnish all materials, supplies, and equipment specified to be incorporated into and form a permanent part of the complete work; (c) provide and perform all necessary labor in a substantial and workmanlike manner and in accordance with the provisions of the Contract Documents; and (d) execute construct, and compete all Work included in and covered by the City's award of this Contract to the Contractor, such award being based on the acceptance by the City of the Contractor's Proposal, or part thereof, as follows:

The City agrees to pay to the Contractor for the performance of the Work embraced in this Contract, the Contractor agrees to accept as full compensation therefor, the following sums and prices for all Work covered by and included in the Contract award and designated above, payment thereof to be made in the manner provided by the City:

\$

## CONTRACT AGREEMENT

The Work included in this Contract shall begin as soon as possible from date of executed contract. The completion shall be \_\_\_\_\_.

### GUARANTEE:

A performance bond in the full amount of the contract shall be required for all construction contracts. This bond shall remain in effect during the guarantee period as stated in the specifications. Once the project is completed, the contractor may submit a maintenance bond in place of the performance bond.

The Contract Documents comprise the Contract, and consist of the following:

1. The Instructions to Proposers
2. The Accepted Proposal
3. The Contract Agreements
4. The Specifications, including all Appendices
- \*5. The City of Lincoln Standard Specifications for Municipal Construction
  - a. General Conditions
  - b. General Specifications
  - c. Construction & Materials Specifications
6. The Plans (including the Schedule of Approximate Quantities)
7. The Construction Bonds
8. The Special Provisions

\* If project includes paving, water, sewer, sidewalk, lighting or traffic signal work, the City of Lincoln Standard Specifications for Municipal Construction will apply, which are on file in the office of the City Clerk. Copies may be obtained at the Office of the City Engineer or at <http://www.lincoln.ne.gov/city/pworks/engine/dconst/standard/stndspec/index.htm> .

## CONTRACT AGREEMENT

These Contract Agreements, together with the other Contract Documents herein above mentioned, form this Contract, and they are as fully a part of the Contract as if hereto attached or herein repeated.

The Contractor and the City hereby agree that all the terms and conditions of this Contract shall by these presents be binding upon themselves, and their heirs, administrators, executors, legal and personal representatives, successors, and assigns.

IN WITNESS WHEREOF, the Contractor and the City do hereby execute this contract.

### **EXECUTION BY THE CITY OF LINCOLN, NEBRASKA**

ATTEST:

CITY OF LINCOLN, NEBRASKA

City Clerk

Mayor

Approved by Executive or No.  
dated

### **EXECUTION BY CONTRACTOR**

IF A CORPORATION:

Name of Corporation

(Address)

ATTEST:

\_\_\_\_\_  
Secretary (SEAL)

By:  
Duly Authorized Official

Legal Title of Official

IF OTHER TYPE OF ORGANIZATION:

Name of Organization

Type of Organization

(Address)

By:  
Member

By:  
Member

IF AN INDIVIDUAL:

Name

Address

Signature



## A. GENERAL INFORMATION

There are two types of construction bonds that are required by statutes for public work in many jurisdictions and are widely used for other projects as well.

Construction Performance Bond

Construction Payment Bond

The Construction Performance Bond is an instrument that is used to assure the availability of funds to complete the construction.

The Construction Payment Bond is an instrument that is used to assure the availability of sufficient funds to pay for labor, materials and equipment used in the construction. For public work the Construction Payment Bond provides rights of recovery for workers and suppliers similar to their rights under the mechanics lien laws applying to private work.

The objective underlying the re-writing of construction bond forms was to make them more understandable to provide guidance to users. The intention was to define the rights and responsibilities of the parties, without changing the traditional rights and responsibilities that have been decided by the courts. The new bond forms provide helpful guidance regarding time periods for various notices and actions and clarify the extent of available remedies.

The concept of pre-default meeting has been incorporated into the Construction Performance Bond. All of the participants favored early and informal resolution of the problems that may precipitate a default, but some Surety companies were reluctant to participate in pre-default settings absent specific authorization in the bond form.

The responsibilities of the Owner and the options available to the Surety when a default occurs are set forth in the Construction Performance Bond. Procedures for making a claim under the Construction Payment Bond are set forth in the form.

EJCDC recommends the use of two separate bonds rather than a combined form. Normally the amount of each bond is 100 percent of the contract amount. The bonds have different purposes and are separate and distinct obligations of the Surety. The Surety Association reports that the usual practice is to charge a single premium for both bonds and there is no reduction in premium for using a combined form or for issuing one bond without the other.

## B. COMPLETING THE FORMS

Bonds have important legal consequences; consultation with an attorney and a bond specialist is encouraged with respect to federal, state and local laws applicable to bonds and with respect to completing or modifying the bond forms.

Both bond forms have a similar format and the information to be filled in is ordinarily the same on both bonds. If modification is necessary, the modifications may be different.

The bond forms are prepared for execution by the Contractor and the Surety. Evidence of authority to bind the Surety is usually provided in the form of a power of attorney designating the agent who is authorized to sign on behalf of the Surety. The power of attorney should be filed with the signed bonds.

Each bond must be executed separately since they cover separate and distinct obligations.

Preferably the bond date should be the same date as the contract, but in no case should the bond date precede the date of the contract.

To accompany the Construction Performance Bond (EJCDC No. 1910-28A) and the Construction Payment Bond (EJCDC No. 1910-28B)  
Prepared by the Engineers' Joint Contract Documents Committee

## CONSTRUCTION PERFORMANCE BOND

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):

SURETY (Name and Principal  
Place of Business):

Owner (Name and Address):

City of Lincoln  
555 South 10th St.  
Lincoln, NE 68508

CONSTRUCTION CONTRACT

Date:

Amount: \$

Description (Name and Location):

BOND

Date (Not earlier than Construction Contract Date)

Amount: \$

Modifications to this Bond Form:

CONTRACTOR AS PRINCIPAL

Company:

(Corp. Seal)

SURETY

Company:

(Corp. Seal)

Signature: \_\_\_\_\_

Name and Title:

Signature: \_\_\_\_\_

Name and Title:

CONTRACTOR AS PRINCIPAL

Company:

(Corp. Seal)

SURETY

Company:

(Corp. Seal)

Signature: \_\_\_\_\_

Name and Title:

Signature: \_\_\_\_\_

Name and Title:

EJCDC NO. 1910-28a (1984 Edition)

Prepared through the joint efforts of The Surety Assoc. of America. Engineers' Joint Contract Documents Committee. The Associated General Contractors of America, and the American Institute of Architects.

## CONSTRUCTION PERFORMANCE BOND

1. The Contractor and the Surety, jointly and severally, bind themselves their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except to participate in conferences as provided in Subparagraph 3.1.

3. If there is no Owner Default, the Surety's obligation under this Bond shall arise after:

3.1 The Owner has notified the Contractor and the Surety at its address described in Paragraph 10 below, that the Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with the Contractor and the Surety to be held not later than fifteen days after receipt of such notice to discuss methods of performing the Construction Contract. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default and

3.2 The Owner has declared a Contractor Default and formally terminated the Contractor's right to complete the contract. Such Contractor Default shall not be declared earlier than twenty days after the Contractor and the Surety have received notice as provided in Sub-paragraph 3.1; and

3.3 The Owner has agreed to pay the Balance of the Contract Price to the Surety in accordance with the terms of the Construction Contract or to a contractor selected to perform the Construction Contract in accordance with the terms of the contract with the Owner.

4. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

4.1 Arrange for the Contractor, with consent of the Owner, to perform and complete the Construction Contract, or

4.2 Undertake to perform and complete the Construction Contract itself, through its agents or through independent contractors; or

4.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for performance and completion of the Construction described in Paragraph 6 in excess of the Balance of the Contract Price incurred by the Owner resulting from the Contractor's default, or

4.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

1. After investigation, determine the amount for which it may be liable to the Owner and as soon as practicable after the amount is determined tender payment therefor to the Owner; or

2. Deny liability in whole or in part and notify the Owner citing reasons therefor.

5. If the Surety does not proceed as provided in Paragraph 4 with reasonable promptness, the Surety shall be deemed to be in default on this Bond fifteen days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Subparagraph 4.4 and the Owner refuses payment tendered or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

6. After the Owner has terminated the Contractor's right to complete the Construction Contract, and if the Surety elects to act under Subparagraph 4.1, 4.2, or 4.3 above, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. To the limit of the amount of this Bond, but subject to commitment by the Owner of the Balance of the Contract Price to mitigation of costs and damages on the Construction Contract, the Surety is obligated without duplication for:

6.1 The responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

6.2 Additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 4; and

6.3 Liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

7. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, or successors.

8. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related sub-contracts, purchase orders and other obligations.

9. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

10. Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the signature page.

11. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

12. Definitions.

12.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

12.2 Construction Contract: The agreement between the Owner and the Contractor identified on the signature page, including all Contract Documents and changes thereto.

12.3 Contractor Default: Failure of the Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Construction Contract.

12.4 Owner Default: Failure of the Owner, which has neither been remedied nor waived, to pay the Contractor as required by the Construction Contract or to perform and complete or comply with the other terms thereof.

CONSTRUCTION PAYMENT BOND

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR (Name and Address):

SURETY (Name and Principal Place  
Of Business):

Owner (Name and Address):

City of Lincoln  
555 South 10th St.  
Lincoln, NE 68508

CONSTRUCTION CONTRACT

Date:

Amount: \$

Description (Name and Location):

BOND

Date (Not earlier than Construction Contract Date):

Amount: \$

Modifications to this Bond Form:

CONTRACTOR AS PRINCIPAL

Company: (Corp. Seal)

SURETY

Company: (Corp. Seal)

Signature: \_\_\_\_\_

Name and Title:

Signature: \_\_\_\_\_

Name and Title:

CONTRACTOR AS PRINCIPAL

Company: (Corp. Seal)

SURETY

Company: (Corp. Seal)

Signature: \_\_\_\_\_

Name and Title:

Signature: \_\_\_\_\_

Name and Title:

EJCDC NO. 1910-28B (1984 Edition)

Prepared through the joint efforts of The Surety Assoc. of America. Engineers' Joint Contract Documents Committee.

The Associated General Contractors of America, and the American Institute of Architects.

## CONSTRUCTION PAYMENT BOND

1. The Contractor and the Surety, jointly and severally, bind themselves their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference.
2. With respect to the Owner, this obligation shall be null and void if the Contractor:
  - 2.1 Promptly makes payment, directly or indirectly, for all sums due Claimants, and
  - 2.2 Defends, indemnifies and holds harmless the Owner from all claims, demands, liens or suits by any person or entity who furnished labor, materials or equipment for use in the performance of the Construction Contract, provided the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 12) of any claims, demands, liens or suits and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety, and provided there is no Owner Default.
3. With respect to Claimants, this obligation shall be null and void if the Contractor promptly makes payment, directly or indirectly, for all sums due.
4. The Surety shall have no obligation to Claimants under this Bond until:
  - 4.1 Claimants who do not have a direct contract with the Contractor have given notice to the Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof to the Owner, stating that a claim is being made under this Bond and with substantial accuracy the amount of the claim.
  - 4.2 Claimants who do not have a direct contract with the Contractor:
    1. Have furnished written notice to the Contractor and sent a copy, or notice thereof, to the Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whom the labor was done or performed, and
    2. Have either received a rejection in whole or in part from the Contractor, or not received within 30 days of furnishing the above notice any communication from the Contractor by which the Contractor has indicated the claim will be paid directly or indirectly; and
    3. Not having been paid within the above 30 days, have sent a written notice to the Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to the Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to the Contractor.
5. If a notice required by Paragraph 4 is given by the Owner to the Contractor or to the Surety, that is sufficient compliance.
6. When the Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at the Surety's expense take the following actions:
  - 6.1 Send an answer to the Claimant, with a copy to the Owner, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.
  - 6.2 Pay or arrange for payment of any undisputed amounts.
7. The Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.
8. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any Construction Performance Bond.
9. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and the Surety under this Bond, subject to the Owner's priority to the funds for the completion of the work.
9. The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.
10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.
11. No suite or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the work or part of the work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Subparagraph 4.1 or Clause 4.1 (iii), or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.
12. Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the signature page. Actual receipt of notice by Surety, the Owner or the Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.
13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted here from and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is, that this Bond shall be construed as a statutory bond and not as a common law bond.
14. Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.
15. DEFINITIONS
  - 15.1 Claimant: An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials, or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.
  - 15.2 Construction Contract: The agreement between the Owner and the Contractor identified on the signature page, including all Contract Documents and changes thereto.
  - 15.3 Owner Default: Failure of the Owner, which has neither been remedied nor waived, to pay the Contractor as required by the Construction Contract or to perform and complete or comply with the other terms thereof.

(FOR INFORMATION ONLY - NAME, ADDRESS AND TELEPHONE)

AGENT OR BROKER: OWNER'S REPRESENTATIVE (ARCHITECT, ENGINEER OR OTHER PARTY)

## **APPENDIX E - INSURANCE REQUIREMENTS**

# INSURANCE REQUIREMENTS

## 1. GENERAL PROVISIONS

- A. **Indemnification.** The Contractor shall indemnify and save harmless the City of Lincoln, Nebraska from and against all losses, claims, damages, and expenses, including attorney's fees, arising out of or resulting from the performance of the contract that results in bodily injury, sickness, disease, death, or to injury to or destruction of tangible property, including the loss of use resulting therefrom and is caused in whole or in part by the Contractor, any subcontractor, any directly or indirectly employed by any of them or anyone for whose acts any of them may be liable. This section will not require the Contractor to indemnify or hold harmless the City of Lincoln for any losses, claims, damages, and expenses arising out of or resulting from the sole negligence of the City of Lincoln, Nebraska.
- B. **Approved Coverage Prior to Commencing Work/Subcontractors Included.** Contractor shall purchase and maintain in place insurance to Protect Contractor and City against all liabilities and hazards as provided in this article throughout the duration of the Contract. Contractor shall not commence work under this contract until the Contractor has obtained all insurance required under this Section and such insurance has been approved by the City Attorney for the City of Lincoln, nor shall the Contractor allow any subcontractor to commence work on any subcontract until all similar insurance required of the subcontractor has been so obtained and approved.
- C. **Occurrence Basis Coverage.** All insurance shall be provided on an **occurrence basis** and not on a claims made basis, except for hazardous materials, errors and omissions, or other coverage not reasonably available on an occurrence basis; provided that all such claims made coverage is subject to the prior written approval of the City Attorney and must be clearly indicated as such in any certificate showing coverage.
- D. **Authorized and Rated Insurers Required.** All insurance coverage are to be placed with insurers authorized to do business in the State of Nebraska and must be placed with an insurer that has an A.M. Best's Rating of no less than A:VII unless specific approval has been granted by the City Attorney.
- E. **Certificates Showing Coverage.** All certificates of insurance shall be filed with the City Attorney, and may utilize an appropriate standard ACORD Certificate of Insurance form showing the specific limits of insurance coverage required by this Article; provided that restrictions, qualifications or declarations inconsistent with the requirements of this Article shall not relieve the Contractor from providing insurance as required herein. Such certificates shall show the City of Lincoln as additional insured, including by specific endorsement where necessary, as indicated in the following requirements. Such certificate shall specifically state that the related insurance policies are to be endorsed to require the insurer to provide the City of Lincoln thirty days, notice of cancellation, non-renewal or any material reduction in the stated amounts or limits of insurance coverage.
- F. **Terminology.** The terms "insurance," "insurance policy," or "coverage" as used in this article are used interchangeably and shall have the same meaning as "insurance" unless the context clearly requires otherwise. References to "ISO®" forms are merely for convenience and ease of reference, and an equivalent or better form as determined acceptable by the City Attorney may be used. (Note: ISO® is a registered trademark of ISO Properties, Inc.)

## 2. INSURANCE REQUIREMENTS

- A. **Scope of Required Coverage.** The Contractor shall take out and maintain during the life of Contract such insurance in the forms and minimum amounts as specified in this Article and as will protect Contractor and City from the following claims arising out of or resulting from or in connection with the Contractor's operations, undertakings or

## INSURANCE REQUIREMENTS

omissions directly or indirectly related to the Contract, whether by the Contractor or any Subcontractor or anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

- (1) Claims under workers' compensation, disability benefit, or other employee benefit acts;
- (2) Claims arising out of bodily injury, occupational sickness or disease, or death of an employee or any other person;
- (3) Claims customarily covered under personal injury liability coverage;
- (4) Claims other than to the work itself arising out of an injury to or destruction of tangible property, including the loss of use resulting therefrom;
- (5) Claims arising out of ownership, maintenance or use of any motor vehicle;
- (6) Railroad protective liability coverage in the event the contract involves work to be performed within 50 feet of any railroad property and affecting any railroad bridge or trestle, tracks, road beds, tunnel, underpass or crossing.

- B. Worker's Compensation Insurance and Employer's Liability Insurance.** The Contractor shall provide applicable statutory Worker's Compensation Insurance with minimum limits as provided below covering all Contractor's employees, and in the case of any subcontracted work, the Contractor shall require the subcontractor similarly to provide Worker's Compensation Insurance for Subcontractor's employees.

The Contractor shall provide Employer's Liability Insurance with minimum limits as provided below placed with an insurance company authorized to write such insurance in all states where the Contractor will have employees located in the performance of this contract, and the Contractor shall require each Subcontractor similarly to maintain Employer's Liability Insurance on the Subcontractor's employees.

| Coverage                    | Listing                   | Min Amt   | Notes         |
|-----------------------------|---------------------------|-----------|---------------|
| <b>Worker's Comp.</b>       |                           |           |               |
|                             | State                     | Statutory |               |
|                             | Applicable Federal        | Statutory |               |
| <b>Employer's Liability</b> |                           |           |               |
|                             | Bodily Injury by accident | \$500,000 | each accident |
|                             | Bodily Injury by disease  | \$500,000 | each employee |
|                             | Bodily Injury             | \$500,000 | policy limit  |

**C. Commercial General Liability Insurance.**

- (1) The Contractor shall provide Commercial General Liability Insurance in a policy form providing no less comprehensive and no more restrictive coverage than provided under the ISO® form CG00010798 or newer with standard exclusions "a" through "o" and with minimum limits as provided below. Any other exclusions that operate to contradict or materially alter the standard exclusions shall be specifically listed on the certificate of insurance and shall be subject to the prior written approval of the City Attorney.



## INSURANCE REQUIREMENTS

| Coverage                          | Min Amt     | Notes          |
|-----------------------------------|-------------|----------------|
| General                           | \$2,000,000 | Aggregate      |
| Products and Completed Operations | \$2,000,000 | Aggregate      |
| Personal and Advertising Injury   | \$1,000,000 |                |
| Each Occurrence                   | \$1,000,000 |                |
| Fire Damage Limit                 | \$ 100,000  | any one fire   |
| Medical Damage Limit              | \$ 10,000   | any one person |

(2) The required Commercial General Liability Insurance shall also include the following:

- Coverage for all premises and operations
  - Endorsement to provide the general aggregate per project endorsement
  - Personal and advertising injury included
  - Operations by independent contractors included
  - Contractual liability coverage included
  - X.C.U. Coverage including coverage for demolition of any building or structure, collapse, explosion, blasting, excavation and damage to property below the surface of ground.
  - Any fellow employee exclusions shall be deleted
  - Coverage shall not contain an absolute pollution exclusion, and applicable remaining coverage shall apply for pollution exposures arising from products and completed operations.
  - Coverage for products and completed operations maintained for duration of work and shall be maintained for a minimum of three years after final acceptance under the Contract or the warranty period for the same whichever is longer, unless modified in any Special Provisions.
  - Contractual Liability coverage shall include contractually assumed defense costs in addition to any policy limits.
- (3) If work is to be performed within 50 feet of any railroad property and affecting any railroad bridge or trestle, tracks, road beds, tunnel, underpass or crossing, Railroad Contractual Liability Endorsement (ISO® form CG24170196 or newer).
- (4) City may at its sole option, and in lieu of being additional insured on the Contractor's policy, by written requirement in the Special Provisions or by written change order, require Contractor to provide a separate Owner's Protective liability policy. The premium cost to obtain such insurance shall be as paid as provided in the Special Provision or change order, with any related cost savings as reasonably determined by the City being reimbursed or paid to the City.

**D. Vehicle liability insurance coverage.**

The Contractor shall provide reasonable insurance coverage for all owned, non-owned, hired and leased vehicles with specific endorsements to include contractual liability coverage and delete any fellow employee exclusion.

- If specifically required in the Special Provisions, the required coverage shall also include an endorsement for auto cargo pollution (ISO® form CA 99 48).
- E. Railroad Protective Liability.** If work is to be performed within 50 feet of any railroad property and affecting any railroad bridge or trestle, tracks, road beds, tunnel,

## INSURANCE REQUIREMENTS

underpass or crossing or otherwise required by the Special Provisions or applicable requirements of an affected railroad, the Contractor shall provide Railroad Protective Liability Insurance naming the affected railroad/s as insured with minimum limits for bodily injury and property damage of \$2,000,000 per occurrence, \$6,000,000 aggregate, or such other limits as required in the Special Provisions or by the affected railroad. The original of the policy shall be furnished to the railroad and a certified copy of the same furnished to the City Attorney's office prior to any related construction or entry upon railroad premises by the Contractor or for work related to the Contract.

F. **Umbrella or Excess Insurance.** The Contractor shall provide Umbrella or Excess insurance coverage with minimum coverage limits of \$3,000,000 each occurrence and aggregate.

G. **City included as Insured on Contractor's Policy – Endorsements required.**

The Contractor shall provide adequate written documentation, including applicable ACORD certificates, declarations pages or other acceptable policy information demonstrating that the City is included as an additional insured along with the Contractor with respect to all of the coverages required in this "Section 2A Insurance Requirements," except for applicable Worker's Compensation coverage, to include all work performed for the City and specifically including, but not limited to, any liability caused or contributed to by the act, error, or omission of the Contractor, including any related subcontractors, third parties, agents, employees, officers or assigns of any of them. The documentation or endorsement shall specifically include the city as an additional insured for purposes of Products and Completed Operations. The inclusion of the City as additional insured shall be for coverage only on a primary basis for liability coverage, and no coverage shall contain a policy or other restriction or attempt to provide restricted coverage for the City, whether on an excess, contributory or other basis regardless of any other insurance coverage available to the City.

### 3. CONTRACTOR'S INDEMNITY – CONTRACTUAL LIABILITY INSURANCE

A. To the same extent as specified for minimum coverage requirements in Section 2 above, the required insurance shall include contractual liability coverage to include indemnification and hold harmless agreements and provisions in the related Contract Documents, specifically including the following provision:

- (1) To the fullest extent permitted by law, Contractor shall defend, indemnify, and hold harmless the City, its officers, agents, employees, volunteers and consultants from and against any and all claims, damages, losses, costs, and expenses, including but not limited to attorney's fees and costs arising out of or related to the Contract or the Contractor's activities, errors, or omissions related to the Contract including liabilities or penalties imposed by applicable, law, rule or regulation in connection therewith; provided that such claims, damages, losses, costs, and expenses, including but not limited to attorney's fees and costs:
  - is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property including the loss of use therefrom, and
  - is caused in whole or in part by any act or omission of the Contractor, any subcontractor, agent, officer, employee, or assigns of the same or by anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in whole or in part by a party indemnified hereunder.
- (2) Such indemnification shall not be construed to negate, abridge, limit or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person described in this section.

## **INSURANCE REQUIREMENTS**

- B. In any and all claims by any employee (whether an employee of the Contractor or subcontractor, or their respective agents or assigns by anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable as an employer) in whole or in part against the City, its officers, agents, employees, volunteers or consultants, the above indemnification shall not be limited in any way by the amount of damages, compensation, benefits or other contributions payable by or on behalf of a the employer under Worker's Compensation statutes, disability benefit acts, or any other employee benefit or payment acts as the case may be.
- C. The obligations of indemnification herein shall not include or extend to:
  - (1) Any outside engineer's or architect's professional errors and omissions involving the approval or furnishing of maps, drawings, opinions, reports, surveys, change orders, designs or specifications within the scope of professional services provided to the City and related to the Contract; and
  - (2) Any claims arising out of the negligence of the City to the extent the same is the sole and proximate cause of the injury or damage so claimed.
- D. In the event of any litigation of any such claims shall be commenced against the City, Contractor shall defend the same at Contractor's sole expense upon notice thereof from the City. Contractor shall notify the insuring company that the City reserves and does not waive any statutory or governmental immunity and neither Contractor, nor Contractor's counsel whether employed by Contractor or by an insurer on behalf of the Contractor shall waive such defenses or enter into any settlement or other disposition requiring waiver of any defenses or immunity of the City without the express written consent of the City.

### **4. CONTRACTOR'S INSURANCE FOR OTHER LOSSES.**

- A. Contractor shall assume full responsibility for all loss or damage from any cause whatsoever to any tools owned, rented or used in connection with the Contract including any tools, machinery, equipment, storage devices, containers, sheds, temporary structures, staging structures, scaffolding, fences, forms, braces, jigs, screens, brackets, vehicles and the like owned or rented by Contractor, or Contractor's agents, subcontractors, suppliers, or employees.
- B. In connection with the above, Contractor shall cause or require any applicable insurance related to physical damage of the same to provide a waiver of a right of subrogation against the City.

### **5. NOTIFICATION IN EVENT OF LIABILITY OR DAMAGE.**

- A. The Contractor shall promptly notify the City in writing and provide a copy of all claims and information presented to any of Contractor's insurance carrier/s upon any loss or claim or upon any occurrence giving rise to any liability or potential liability related to the Contract or related work. The notice to the City shall include pertinent details of the claim or liability and an estimate of damages, names of witnesses, and other pertinent information including the amount of the claim, if any.
- B. In the event the City receives a claim or otherwise has actual knowledge of an any loss or claim arising out of the Contract or related work and not otherwise known to or made against the Contractor, the City shall promptly notify the Contractor of the same in writing, including pertinent details of the claim or liability; Provided, however the City shall have no duty to inspect the project to obtain such knowledge, and provided further that the City's obligations, if any, shall not relieve the Contractor of any liability or obligation hereunder.

### **6. PROPERTY INSURANCE/ BUILDER'S RISK.**

## **INSURANCE REQUIREMENTS**

- A. The Contractor shall provide property insurance (a/k/a Builder's Risk or installation Floater) on all Projects involving construction or installation of buildings or structures and other projects where provided in the Special Provisions. Such insurance shall be provided in the minimum amount of the total contract sum and in addition applicable modifications thereto for the entire work on a replacement cost basis. Such insurance shall be maintained until the City completes final acceptance of the work as provided in the Contract. Such insurance shall be written and endorsed, where applicable, to include the interests of the City, Contractor, Subcontractors, Sub-subcontractors in the related work. The maximum deductible for such insurance shall be \$5,000 for each occurrence, which deductible shall be the responsibility of the Contractor. Such insurance shall contain a "permission to occupy" endorsement.
- B. All related Property Insurance shall be provided on a "Special Perils" or similar policy form and shall at a minimum insure against perils of fire including extended coverage and physical loss or damage including without limitation or duplication of coverage: flood, earthquake, theft, vandalism, malicious mischief, collapse, and debris removal, including demolition whether occasioned by the loss or by enforcement of applicable legal or safety requirements including compensation or costs for City's related costs and expenses (as owner) including labor required as a result of such loss.
- C. All related Property Insurance shall include coverage for falsework, temporary buildings, work stored off-site or in-transit to the site, whether in whole or in part. Coverage for work off-site or in-transit shall be a minimum of 10% of the amount of the policy.
- D. The Contractor's Property Insurance shall be primary coverage for any insured loss related to or arising out of the Contract and shall not be reduced by or coordinated with separate property insurance maintained by the City.

Approved by City Law Department, April 1, 2005

## **APPENDIX F - FEDERAL TRANSIT ADMINISTRATION CONTRACT REQUIREMENTS**

# FEDERAL TRANSIT AUTHORITY

## CONTRACT REQUIREMENTS

**(A) Fly America Requirements** - The Contractor agrees to comply with 49 U.S.C. 40118 (the "Fly America" Act) in accordance with the General Services Administration's regulations at 41 CFR Part 301-10, which provide that recipients and subrecipients of Federal funds and their contractors are required to use U.S. Flag air carriers for U.S Government-financed international air travel and transportation of their personal effects or property, to the extent such service is available, unless travel by foreign air carrier is a matter of necessity, as defined by the Fly America Act. The Contractor shall submit, if a foreign air carrier was used, an appropriate certification or memorandum adequately explaining why service by a U.S. flag air carrier was not available or why it was necessary to use a foreign air carrier and shall, in any event, provide a certificate of compliance with the Fly America requirements. The Contractor agrees to include the requirements of this section in all subcontracts that may involve international air transportation.

**(B) Cargo Preference - Use of United States-Flag Vessels** - The contractor agrees:

- (1) to use privately owned United States-Flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to the underlying contract to the extent such vessels are available at fair and reasonable rates for United States-Flag commercial vessels;
- (2) to furnish within 20 working days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, "on-board" commercial ocean bill-of-lading in English for each shipment of cargo described in the preceding paragraph to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590 and to the FTA recipient (through the contractor in the case of a subcontractor's bill-of-lading.)
- (3) to include these requirements in all subcontracts issued pursuant to this contract when the subcontract may involve the transport of equipment, material, or commodities by ocean vessel.

**(C) Energy Conservation** - The contractor agrees to comply with mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act.

**(D) Clean Water** –

- (1) The Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 et seq. The Contractor agrees to report each violation to the Purchaser and understands and agrees that the Purchaser will, in turn, report each violation as required to assure notification to FTA and the appropriate EPA Regional Office.
- (2) The Contractor also agrees to include these requirements in each subcontract exceeding \$100,000 financed in whole or in part with Federal assistance provided by FTA.

**(E) Access to Records** - The following access to records requirements apply to this Contract:

- (1) Where the Purchaser is not a State but a local government and is the FTA Recipient or a subgrantee of the FTA Recipient in accordance with 49 C. F. R. 18.36(i), the Contractor agrees to provide the Purchaser, the FTA Administrator, the Comptroller General of the United States or any of their authorized representatives access to any books, documents, papers and records of the Contractor which are directly pertinent to this contract for the purposes of making audits, examinations, excerpts and transcriptions. Contractor also agrees, pursuant to 49 C. F. R. 633.17 to provide the FTA Administrator or his authorized representatives including any PMO Contractor access to Contractor's records and construction sites pertaining to a major capital project, defined at 49 U.S.C. 5302(a)1, which is receiving federal financial assistance through the programs described at 49 U.S.C. 5307, 5309 or 5311.
- (2) Where the Purchaser is a State and is the FTA Recipient or a subgrantee of the FTA Recipient in accordance with 49 C.F.R. 633.17, Contractor agrees to provide the Purchaser, the FTA Administrator or his authorized representatives, including any PMO Contractor, access to the Contractor's records and construction sites pertaining to a major capital project, defined at 49 U.S.C. 5302(a)1, which is receiving federal financial assistance through the programs described at 49 U.S.C. 5307, 5309 or 5311.

## FEDERAL TRANSIT AUTHORITY

### CONTRACT REQUIREMENTS

By definition, a major capital project excludes contracts of less than the simplified acquisition threshold currently set at \$100,000.

- (3) Where the Purchaser enters into a negotiated contract for other than a small purchase or under the simplified acquisition threshold and is an institution of higher education, a hospital or other non-profit organization and is the FTA Recipient or a subgrantee of the FTA Recipient in accordance with 49 C.F.R. 19.48, Contractor agrees to provide the Purchaser, FTA Administrator, the Comptroller General of the United States or any of their duly authorized representatives with access to any books, documents, papers and record of the Contractor which are directly pertinent to this contract for the purposes of making audits, examinations, excerpts and transcriptions.
- (4) Where any Purchaser which is the FTA Recipient or a subgrantee of the FTA Recipient in accordance with 49 U.S.C. 5325(a) enters into a contract for a capital project or improvement (defined at 49 U.S.C. 5302(a)1) through other than competitive bidding, the Contractor shall make available records related to the contract to the Purchaser, the Secretary of Transportation and the Comptroller General or any authorized officer or employee of any of them for the purposes of conducting an audit and inspection.
- (5) The Contractor agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonably needed.
- (6) The Contractor agrees to maintain all books, records, accounts and reports required under this contract for a period of not less than three years after the date of termination or expiration of this contract, except in the event of litigation or settlement of claims arising from the performance of this contract, in which case Contractor agrees to maintain same until the Purchaser, the FTA Administrator, the Comptroller General, or any of their duly authorized representatives, have disposed of all such litigation, appeals, claims or exceptions related thereto. Reference 49 CFR 18.39(i)(11).
- (7) FTA does not require the inclusion of these requirements in subcontracts.

**(F) Federal Changes** - Contractor shall at all times comply with all applicable FTA regulations, policies, procedures and directives, including without limitation those listed directly or by reference in the [Master Agreement](#) between Purchaser and FTA, as they may be amended or promulgated from time to time during the term of this contract. Contractor's failure to so comply shall constitute a material breach of this contract.

**(G) Clean Air** –

- (1) The Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. §§ 7401 *et seq* . The Contractor agrees to report each violation to the Purchaser and understands and agrees that the Purchaser will, in turn, report each violation as required to assure notification to FTA and the appropriate EPA Regional Office.
- (2) The Contractor also agrees to include these requirements in each subcontract exceeding \$100,000 financed in whole or in part with Federal assistance provided by FTA.

**(H) Recovered Materials** - The contractor agrees to comply with all the requirements of Section 6002 of the Resource Conservation and Recovery Act (RCRA), as amended (42 U.S.C. 6962), including but not limited to the regulatory provisions of 40 CFR Part 247, and Executive Order 12873, as they apply to the procurement of the items designated in Subpart B of 40 CFR Part 247.

**(I) No Obligation by the Federal Government** -

- (1) The Purchaser and Contractor acknowledge and agree that, notwithstanding any concurrence by the Federal Government in or approval of the solicitation or award of the underlying contract, absent the express written consent by the Federal Government, the Federal Government is not a party to this contract and shall not be subject to any obligations or liabilities to the Purchaser, Contractor, or any other party (whether or not a party to that contract) pertaining to any matter resulting from the underlying contract.
- (2) The Contractor agrees to include the above clause in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further agreed that the clause shall not be modified, except to identify the subcontractor who will be subject to its provisions.

# FEDERAL TRANSIT AUTHORITY

## CONTRACT REQUIREMENTS

### (J) Program Fraud and False or Fraudulent Statements or Related Acts -

- (1) The Contractor acknowledges that the provisions of the Program Fraud Civil Remedies Act of 1986, as amended, 31 U.S.C. § 3801 et seq. and U.S. DOT regulations, "Program Fraud Civil Remedies," 49 C.F.R. Part 31, apply to its actions pertaining to this Project. Upon execution of the underlying contract, the Contractor certifies or affirms the truthfulness and accuracy of any statement it has made, it makes, it may make, or causes to be made, pertaining to the underlying contract or the FTA assisted project for which this contract work is being performed. In addition to other penalties that may be applicable, the Contractor further acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification, the Federal Government reserves the right to impose the penalties of the Program Fraud Civil Remedies Act of 1986 on the Contractor to the extent the Federal Government deems appropriate.
- (2) The Contractor also acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification to the Federal Government under a contract connected with a project that is financed in whole or in part with Federal assistance originally awarded by FTA under the authority of 49 U.S.C. § 5307, the Government reserves the right to impose the penalties of 18 U.S.C. § 1001 and 49 U.S.C. § 5307(n)(1) on the Contractor, to the extent the Federal Government deems appropriate.
- (3) The Contractor agrees to include the above two clauses in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further agreed that the clauses shall not be modified, except to identify the subcontractor who will be subject to the provisions.

### (K) Contract Termination -

- (1) **Termination for Convenience** The City may terminate this contract, in whole or in part, at any time by written notice to the Contractor when it is in the Government's best interest. The Contractor shall be paid its costs, including contract close-out costs, and profit on work performed up to the time of termination. The Contractor shall promptly submit its termination claim to the City to be paid the Contractor. If the Contractor has any property in its possession belonging to the City, the Contractor will account for the same, and dispose of it in the manner the City directs.
- (2) **Termination for Default [Breach or Cause]** If the Contractor does not deliver supplies in accordance with the contract delivery schedule, or, if the contract is for services, the Contractor fails to perform in the manner called for in the contract, or if the Contractor fails to comply with any other provisions of the contract, the City may terminate this contract for default. Termination shall be effected by serving a notice of termination on the contractor setting forth the manner in which the Contractor is in default. The contractor will only be paid the contract price for supplies delivered and accepted, or services performed in accordance with the manner of performance set forth in the contract.

If it is later determined by the City that the Contractor had an excusable reason for not performing, such as a strike, fire, or flood, events which are not the fault of or are beyond the control of the Contractor, the City, after setting up a new delivery of performance schedule, may allow the Contractor to continue work, or treat the termination as a termination for convenience.

- (3) **Opportunity to Cure** The City in its sole discretion may, in the case of a termination for breach or default, allow the Contractor ten (10) days in which to cure the defect. In such case, the notice of termination will state the time period in which cure is permitted and other appropriate conditions

If Contractor fails to remedy to the City's satisfaction the breach or default of any of the terms, covenants, or conditions of this Contract within ten (10) days after receipt by Contractor of written notice from the City setting forth the nature of said breach or default, the City shall have the right to terminate the Contract without any further obligation to Contractor. Any such termination for default shall not in any way operate to preclude the City from also pursuing all available remedies against Contractor and its sureties for said breach or default.

- (4) **Waiver of Remedies for any Breach** In the event that the City elects to waive its remedies for any breach by Contractor of any covenant, term or condition of this Contract, such waiver by the City shall



# FEDERAL TRANSIT AUTHORITY

## CONTRACT REQUIREMENTS

not limit the City's remedies for any succeeding breach of that or of any other term, covenant, or condition of this Contract.

- (5) **Termination for Default** If the Contractor fails to deliver supplies or to perform the services within the time specified in this contract or any extension or if the Contractor fails to comply with any other provisions of this contract, the City may terminate this contract for default. The City shall terminate by delivering to the Contractor a Notice of Termination specifying the nature of the default. The Contractor will only be paid the contract price for supplies delivered and accepted, or services performed in accordance with the manner or performance set forth in this contract.

If, after termination for failure to fulfill contract obligations, it is determined that the Contractor was not in default, the rights and obligations of the parties shall be the same as if the termination had been issued for the convenience of the City.

### **(L) Suspension and Debarment**

This contract is a covered transaction for purposes of 49 CFR Part 29. As such, the contractor is required to verify that none of the contractor, its principals, as defined at 49 CFR 29.995, or affiliates, as defined at 49 CFR 29.905, are excluded or disqualified as defined at 49 CFR 29.940 and 29.945.

The contractor is required to comply with 49 CFR 29, Subpart C and must include the requirement to comply with 49 CFR 29, Subpart C in any lower tier covered transaction it enters into.

By signing and submitting its bid or proposal, the bidder or proposer certifies as follows:

The certification in this clause is a material representation of fact relied upon by the City. If it is later determined that the bidder or proposer knowingly rendered an erroneous certification, in addition to remedies available to the City, the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment. The bidder or proposer agrees to comply with the requirements of 49 CFR 29, Subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

### **(M) Civil Rights** - The following requirements apply to the underlying contract:

- (1) **Nondiscrimination** - In accordance with Title VI of the Civil Rights Act, as amended, 42 U.S.C. § 2000d, section 303 of the Age Discrimination Act of 1975, as amended, 42 U.S.C. § 6102, section 202 of the Americans with Disabilities Act of 1990, 42 U.S.C. § 12132, and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees that it will not discriminate against any employee or applicant for employment because of race, color, creed, national origin, sex, age, or disability. In addition, the Contractor agrees to comply with applicable Federal implementing regulations and other implementing requirements FTA may issue.

- (2) **Equal Employment Opportunity** - The following equal employment opportunity requirements apply to the underlying contract:

(a) **Race, Color, Creed, National Origin, Sex** - In accordance with Title VII of the Civil Rights Act, as amended, 42 U.S.C. § 2000e, and Federal transit laws at 49 U.S.C. § 5332, the Contractor agrees to comply with all applicable equal employment opportunity requirements of U.S. Department of Labor (U.S. DOL) regulations, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor," 41 C.F.R. Parts 60 et seq., (which implement Executive Order No. 11246, "Equal Employment Opportunity," as amended by Executive Order No. 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," 42 U.S.C. § 2000e note), and with any applicable Federal statutes, executive orders, regulations, and Federal policies that may in the future affect construction activities undertaken in the course of the Project. The Contractor agrees to take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, creed, national origin, sex, or age. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising,

# FEDERAL TRANSIT AUTHORITY

## CONTRACT REQUIREMENTS

layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

(b) Age - In accordance with section 4 of the Age Discrimination in Employment Act of 1967, as amended, 29 U.S.C. § 623 and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees to refrain from discrimination against present and prospective employees for reason of age. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

(c) Disabilities - In accordance with section 102 of the Americans with Disabilities Act, as amended, 42 U.S.C. § 12112, the Contractor agrees that it will comply with the requirements of U.S. Equal Employment Opportunity Commission, "Regulations to Implement the Equal Employment Provisions of the Americans with Disabilities Act," 29 C.F.R. Part 1630, pertaining to employment of persons with disabilities. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

- (3) The Contractor also agrees to include these requirements in each subcontract financed in whole or in part with Federal assistance provided by FTA, modified only if necessary to identify the affected parties.

### **(N) Breaches and Dispute Resolution -**

- (1) **Disputes** - Disputes arising in the performance of this Contract which are not resolved by agreement of the parties shall be decided in writing by the authorized representative of the City's Project Manager. This decision shall be final and conclusive unless within ten (10) days from the date of receipt of its copy, the Contractor mails or otherwise furnishes a written appeal to the Project Manager. In connection with any such appeal, the Contractor shall be afforded an opportunity to be heard and to offer evidence in support of its position. The decision of the Project Manager shall be binding upon the Contractor and the Contractor shall abide by the decision.
- (2) **Performance During Dispute** - Unless otherwise directed by the City, Contractor shall continue performance under this Contract while matters in dispute are being resolved.
- (3) **Claims for Damages** - Should either party to the Contract suffer injury or damage to person or property because of any act or omission of the party or of any of his employees, agents or others for whose acts he is legally liable, a claim for damages therefor shall be made in writing to such other party within a reasonable time after the first observance of such injury or damage.
- (4) **Remedies** - Unless this contract provides otherwise, all claims, counterclaims, disputes and other matters in question between the City and the Contractor arising out of or relating to this agreement or its breach will be decided by arbitration if the parties mutually agree, or in a court of competent jurisdiction within the State in which the City is located.
- (5) **Rights and Remedies** - The duties and obligations imposed by the Contract Documents and the rights and remedies available thereunder shall be in addition to and not a limitation of any duties, obligations, rights and remedies otherwise imposed or available by law. No action or failure to act by the City, (Architect) or Contractor shall constitute a waiver of any right or duty afforded any of them under the Contract, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach thereunder, except as may be specifically agreed in writing.

### **(O) Disadvantaged Business Enterprises -**

- (1) This contract is subject to the requirements of Title 49, Code of Federal Regulations, Part 26, *Participation by Disadvantaged Business Enterprises in Department of Transportation Financial Assistance Programs*. A separate contract goal has not been established for this procurement.
- (2) The contractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of this DOT-assisted contract. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this

## FEDERAL TRANSIT AUTHORITY

### CONTRACT REQUIREMENTS

contract or such other remedy as the City deems appropriate. Each subcontract the contractor signs with a subcontractor must include the assurance in this paragraph (see 49 CFR 26.13(b)).

- (3) The successful bidder/offeror will be required to report its DBE participation obtained through race-neutral means throughout the period of performance.
- (4) The contractor is required to pay its subcontractors performing work related to this contract for satisfactory performance of that work no later than 30 days after the contractor's receipt of payment for that work from the City. In addition, the contractor may not hold retainage from its subcontractors.
- (5) The contractor must promptly notify the City, whenever a DBE subcontractor performing work related to this contract is terminated or fails to complete its work, and must make good faith efforts to engage another DBE subcontractor to perform at least the same amount of work. The contractor may not terminate any DBE subcontractor and perform that work through its own forces or those of an affiliate without prior written consent of the City.

**(P) State and Local Law Disclaimer** - The use of many of the suggested clauses are not governed by Federal law, but are significantly affected by State law. The language of the suggested clauses may need to be modified depending on state law, and that before the suggested clauses are used in the grantees procurement documents, the grantees should consult with their local attorney.

**(Q) Incorporation of Federal Transit Administration (FTA) Terms** - The preceding provisions include, in part, certain Standard Terms and Conditions required by DOT, whether or not expressly set forth in the preceding contract provisions. All contractual provisions required by DOT, as set forth in [FTA Circular 4220.1E](#) are hereby incorporated by reference. Anything to the contrary herein notwithstanding, all FTA mandated terms shall be deemed to control in the event of a conflict with other provisions contained in this Agreement. The Contractor shall not perform any act, fail to perform any act, or refuse to comply with any City requests which would cause the City to be in violation of the FTA terms and conditions.

## **APPENDIX G - INSTRUCTIONS TO PROPOSERS**

# INSTRUCTIONS TO PROPOSERS

## CITY OF LINCOLN, NEBRASKA

### PURCHASING DIVISION

#### **1. PROPOSAL PROCEDURE**

- 1.1 Each RFP must be legibly printed in ink or typed, include full name, business address, telephone number, fax number and email address of the Proposer; and be signed in ink by the Proposer.
- 1.2 Response by a firm/organization other than a corporation must include the name and address of each member.
- 1.3 A response by a corporation must be signed in the name of such corporation by a duly authorized official thereof.
- 1.4 Any person signing a response for a firm, corporation, or other organization must show evidence of his authority so to bind such firm, corporation, or organization.
- 1.5 Proposals received after the time and date established for receiving offers will be rejected.

#### **2. EQUAL OPPORTUNITY**

- 2.1 Each proposer agrees that it shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, disability, national origin, age, or marital status. In the employment of persons, proposer shall take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to race, color, religion, sex, disability, national origin, age, or marital status.

#### **3. DATA PRIVACY**

- 3.1 Proposer agrees to abide by all applicable State and Federal laws and regulations concerning the handling and disclosure of private and confidential information concerning individuals and corporations as to inventions, copyrights, patents and patent rights.
- 3.2 The proposer agrees to hold the City harmless from any claims resulting from the proposer's unlawful disclosure or use of private or confidential information.

#### **4. PROPOSER'S REPRESENTATION**

- 4.1 Each proposer by signing and submitting an offer, represents that he/she has read and understands the specification documents, and the offer has been made in accordance therewith.
- 4.2 Each offer for services further represents that the proposer is familiar with the local conditions under which the work and has correlated the observations with the requirements of the RFP.

#### **5. SPECIFICATION CLARIFICATION**

- 5.1 Proposers shall promptly notify the Purchasing Agent of any ambiguity, inconsistency or error which they may discover upon examination of specification documents.

- 5.2 Proposers desiring clarification or interpretation of the specification documents shall make a written request which must reach the Purchasing Agent at least seven (7) calendar days prior to date and time for response receipt, unless otherwise noted in RFP.

- 5.3 Interpretations, corrections and changes made to the specification documents will be made by written addenda.

- 5.4 Oral interpretations/changes to Specification Documents made in any other manner, will not be binding on the City; proposers shall not rely upon oral interpretations.

#### **6. ADDENDA**

- 6.1 Addenda are written documents issued by the City prior to the date for receipt of offers which modify or interpret the specification document by addition, deletion, clarification or correction.
- 6.2 Addenda will be mailed or delivered to all who are known by the City to have received a complete set of specification documents.
- 6.3 Copies of addenda will be made available for inspection at the office of the Purchasing Agent.
- 6.4 No addendum will be issued later than forty-eight (48) hours prior to the date and time for receipt of offers, except an addendum withdrawing the RFP, or addendum including postponement.
- 6.5 Proposers shall ascertain prior to submitting their offer that they have received all addenda issued, and they shall acknowledge receipt of addenda in their proposal.

#### **7. ANTI-LOBBYING PROVISION**

- 7.1 During the period between the proposal advertisement date and the contract award, proposers, including their agents and representatives, shall not lobby or promote their proposal with any member of the City Council or City Staff.

#### **8. EVALUATION AND AWARD**

- 8.1 The signed proposal shall be considered an offer on the part of the proposer. Such offer shall be deemed accepted upon issuance by the City of purchase orders, contract award notifications, or other contract documents appropriate to the work.
- 8.2 No offer shall be withdrawn for a period of ninety (90) calendar days after the time and date established for receiving offers, and each proposer agrees in submitting an offer.
- 8.3 In case of a discrepancy between the unit prices and their extensions, the unit prices shall govern.
- 8.4 The RFP process is designed to be a competitive negotiation platform, where price is not required to be the sole determinative factor; also the City has the flexibility to

# INSTRUCTIONS TO PROPOSERS

## CITY OF LINCOLN, NEBRASKA

### PURCHASING DIVISION

negotiate with a select firm or selected firms to arrive at a mutually agreeable relationship.

- 8.5 A committee will be assigned the task of reviewing the proposals received.

8.5.1 The committee may request documentation from Proposer(s) of any information provided in their proposal response, or require the Proposer to clarify or expand qualification statements.

8.5.2 The committee may also require a site visit and/or verbal interview with a Proposer or select group of Proposers to clarify and expand upon the proposal response.

- 8.6 The offer will be awarded to the lowest responsive, responsible proposer whose proposal will be most advantageous to the City, and as the City deem will best serve their requirements.

- 8.7 The City reserves the right to accept or reject any or all offers, parts of offers; request new proposals, waive irregularities and technicalities in offers; or to award the RFP on a split-order basis, or lump-sum basis; such as shall best serve the requirements and interests of the City.

#### **9. INDEMNIFICATION**

- 9.1 The proposer shall indemnify and save harmless the City of Lincoln, Nebraska from and against all losses, claims, damages, and expenses, including, attorney's fees arising out of or resulting from the performance of the contract that results in bodily injury, sickness, disease, death, or to injury to or destruction of tangible property, including the loss of use resulting therefrom and is caused in whole or in part by the proposer, any subcontractor, any directly or indirectly employed by any of them or anyone for whose acts any of them may be liable. This section will not require the proposer to indemnify or hold harmless the City of Lincoln for any losses, claims damages, and expenses arising out of or resulting from the sole negligence of the City of Lincoln, Nebraska.

- 9.2 In any and all claims against the City or any of its members, officers or employees by an employee of the proposer, any subcontractor, anyone directly or indirectly employed by any of them or by anyone for whose acts made by any of them may be liable, the indemnification obligation under paragraph 9.1 shall not be limited in any way by any limitation of the amount or type of damages, compensation or benefits payable by or for the bidder/proposer or any subcontractor under worker's or workmen's compensation acts, disability benefit acts or other employee benefit acts.

#### **10. LAWS**

- 10.1 The Laws of the State of Nebraska shall govern the rights, obligations, and remedies of the Parties under this proposal and any agreement reached as a result of this process.

- 10.2 Proposer agrees to abide by all applicable State and Federal laws and regulations concerning the handling and disclosure of private and confidential information concerning individuals and corporations as to inventions, copyrights, patents and patent rights.

#### **11. AWARD**

- 11.1 The RFP process is designed to be a competitive negotiation platform, where price is not required to be the sole determinative factor; also the City has the flexibility to negotiate with a selected firm or firms to arrive at a mutually agreeable relationship.

- 11.2 The City shall be the sole judge as to merits of the proposal, and the City's decision will be final.

- 11.3 A committee will be assigned by the Mayor with the task of reviewing the proposals received.

11.3.1 The committee may request documentation from Proposer(s) of any information provided in their proposal response, or require the proposer to clarify or expand qualification statements.

11.3.2 A short list of firms from proposals submitted may be selected for a presentation to the committee and ranked by committee members.

- 11.4 Final approval to enter into contract negotiations with the top ranked firm will be by the Mayor of the City of Lincoln.

- 11.5 The City shall not be liable for any expense incurred in connection with preparation of a response to this RFP.

- 11.6 The contract document shall incorporate by reference all requirements, terms and conditions of the solicitation, proposal received and all negotiated details.

#### **12. LIVING WAGE**

- 12.1 The bidders/proposers agree to pay all employees employed in the performance of this contract, a base wage of not less than the City Living Wage per Section 2.81 of the Lincoln Municipal Code. This wage is subject to change every July.